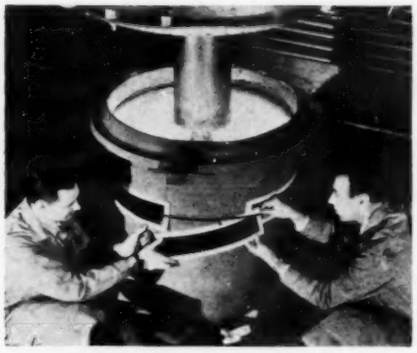
AMERICAN MACHINIST

March 5, 1941



Seeing Through Steel — *Engineers place films over the welded joint of a fabricated pot before radiographing with G.E.'s new 1,000,000-volt X-ray unit*

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December 26, 1940

Mr. Burnham Finney, Editor
American Machinist,
330 W. 42nd Street,
New York, N. Y.

Dear Mr. Finney:

Replying to your letter of December 11.

In our younger years, when we lived in a small city, we found that most of the residents thought they knew how to run the local newspaper or the hotel better than the owners. In later years, through contacts with men in many lines of business, we have learned about some of the problems in other industries, and now we are very loath to suggest to any one a way to improve a business in which we have never been active.

Truthfully, we do not think we could offer you a good idea even if we had the temerity to try. The American Machinist is everything that we could wish for. We are very much pleased with the articles on production of armaments and other things, and the variety and number of things advertised furnish additional suggestions.

Please accept our sincere compliments on the entire magazine from cover to cover, and especially its editorial policy.

Yours very truly,

RICHARDSON ROD & REEL CO.

John A. Cook
President

"The American Machinist is everything that we could wish for."

We feel that each of our more than 20,000 subscribers is a co-editor of *American Machinist*, thus has a right to suggest how it may be made more useful for him. Mr. Finney writes to a different group each month, outlining our immediate editorial program, and asking for suggestions. Mr. Cook's kind letter is in reply to such a request.

WHAT'S IN THIS ISSUE

ASIDE

Apropos of absolutely nothing, we'd like to pass along this little gem before we get down to more serious business. We pride ourself on answering any and all questions having to do with metal-working, whether they come over the phone, in a letter, or scratched on the back of a broken hacksaw blade. But a recent phone call had us stopped. A feminine voice of the type you'd associate with Katherine Hepburn asked, "How much does a machine shop cost?" We tried to explain that a machine shop was a slightly different kind of item from a Coca-Cola or other fixed-priced commodity, but from the very beginning she had us on the defensive. "All I can say," she asserted in conclusion, "is humppt!"

Next time her magazine publishes over two million copies containing a full-page picture of an apprentice operating a milling machine, which it calls an automatic lathe, we'll "humppt!" right back.

INSIDE DOPE

Ordinarily you wouldn't think there is much connection between Shakespeare and X-rays, and ordinarily we wouldn't either. But just to show how far you can go in reading into The Bard more than he intended, we present the quotation on page 149.

The article, incidentally, pays considerably more attention to X-rays than it does to William. This we consider all to the good, since much has been accomplished in the field of X-rays since he wrote The Tempest, or, for that matter, Hamlet. R. Baldwin's article, An Inside Look at Welds, on the other hand, is right up to the minute on X-ray testing technique. Mr. Baldwin is associated with the works laboratory in the General Electric Company and, as the saying goes, is in the know. We think you'll find his information highly valuable.

BATTLE

Since time immemorial, verbal battles have raged long and loud between authorities on best ways to do things. You'd think that as human knowledge increased, these arguments would abate. But no. It seems that every time something new is learned it gives everyone something else to argue over, a fact long deplored by scientists and searchers of The Truth. Engineering, being a compromise between many factors, provides hundreds of disputed points. Obviously the same is true of metal-working. Aluminum vs. stainless, welding vs. casting, tubing vs. bar—to mention only a few. If you're interested in the latter, we suggest Hal Strouse's article on page 153, which details a case history to support one side of the argument. Mr. Strouse is with the Steel & Tube Division of Timken Roller Bearing, and if his example favors use of tubing, it's purely coincidental.

FINALE

A casual glimpse at the physical characteristics of aluminum is enough to make most metal-workers grateful that it's a commercial metal instead of

J. T. WEINZIERL and C. D. MYERS

. . . a liability proves an asset

a laboratory curiosity like beryllium. For, with the exception of a disappointing Young's Modulus, aluminum indeed has everything. "Nature made it light, research made it strong," the Aluminum Company used to advertise. True, true. But not stiff. Which, like other apparent drawbacks, often proves an advantage. In stamping and coining, for instance, aluminum's ability to flow under reasonable pressures is anything but a hindrance. Excellent ductility and malleability make it very suitable for heavy embossing. On page 154 J. T. Weinzierl and C. D. Myers, of the Aluminum Company of America, outline the development of these processes and give pointers as to their use. The article's the last one in the series, which, we feel, discussed just about everything dealing with the cold working of sheet aluminum.

SUGGESTION

A certain Mr. Dale Carnegie, of whom you undoubtedly have heard, has made quite a success telling others how to be a success. Prominent among his pointers—aside from the Golden Rule and other obvious Sunday School tenets—is the power of suggestion. For it's Mr. Carnegie's idea that if you "tell" a man to do something he rebels; "suggest" it to him and he's putty in your hands. Few men are in a position to tell others what to do, yet that doesn't mean all the good ideas are concentrated at the top. Many organizations have long recognized this, and have invited their employees to contribute suggestions concerning general or specific improvements. On the surface this idea seems innocuous enough, yet most suggestion plans are packed with potential dynamite. On page 158 Clifford Stubbs describes a plan that works smoothly for Bryant Chucking Grinder. Possibly it could work as well for you.

COMING

Unaccustomed as we are to public boasting, we feel you'll agree when we say we've done a superb job on our next number. It is devoted to that tireless unappreciated drone, The Tool Engineer, who, for the first time in ages, has been discovered and praised even by the newspapers. Not because he is suddenly in the limelight, but because of his importance in present production problems, do we devote an entire issue to him. It is timed to coincide with his Machine & Tool Progress Exhibition in Detroit, so it gives us a chance really to go to town. In addition to a raft of articles dealing with various phases of tooling, there'll be a special blue section on tool and die steels, a summary of events and exhibits at the show to help those who are going, and a Show-in-Print section for the benefit also of those who aren't. Articles of importance to all in the March 19 AMERICAN MACHINIST!

ADVERTISING PAGES REMOVED

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The Cincinnati Planer Co.
Cincinnati, Ohio

ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

An Inside Look at Welds

BY R. BALDWIN, SCHENECTADY WORKS LABORATORY, GENERAL ELECTRIC COMPANY

"Let there be some more tests made of my metal," wrote William Shakespeare many years ago. It's safe to assume that he wasn't thinking of the X-ray; but this process has become the "some more" for weld checking

INDUSTRIAL X-RAY and welding, from a laboratory point-of-view, were developed almost simultaneously at General Electric. At an early date, welding engineers within the company recognized X-ray as a convenient tool in the development of welding electrodes and welding procedures. In the factory, welding supervisors tried out their new ideas by welding test samples and having them radiographed. The fact that an engineer could actually look into welds almost before his plates were cool made the X-ray laboratory a logical first step in the solution of welding problems.

At present, most of the weld test plates sent to the X-ray laboratory at Schenectady can be handled in the room installed in 1930. This room contains a 200-kv. outfit and, in the interest of speed, no attempt is made to X-ray plates more than 1½ in. thick in this room. When it is necessary to X-ray weld test plates more than 1½ in. thick, the 400-kv. installation shown in Fig. 1 is used. Recently a 1,000,000-volt machine has been installed. The first X-ray machine of such capacity in industrial use, this unit speeds up examination of castings and welds of considerable thickness. The quantity of weld test plate work, and the demand for more and more detail in weld radiographs, has led to the development of

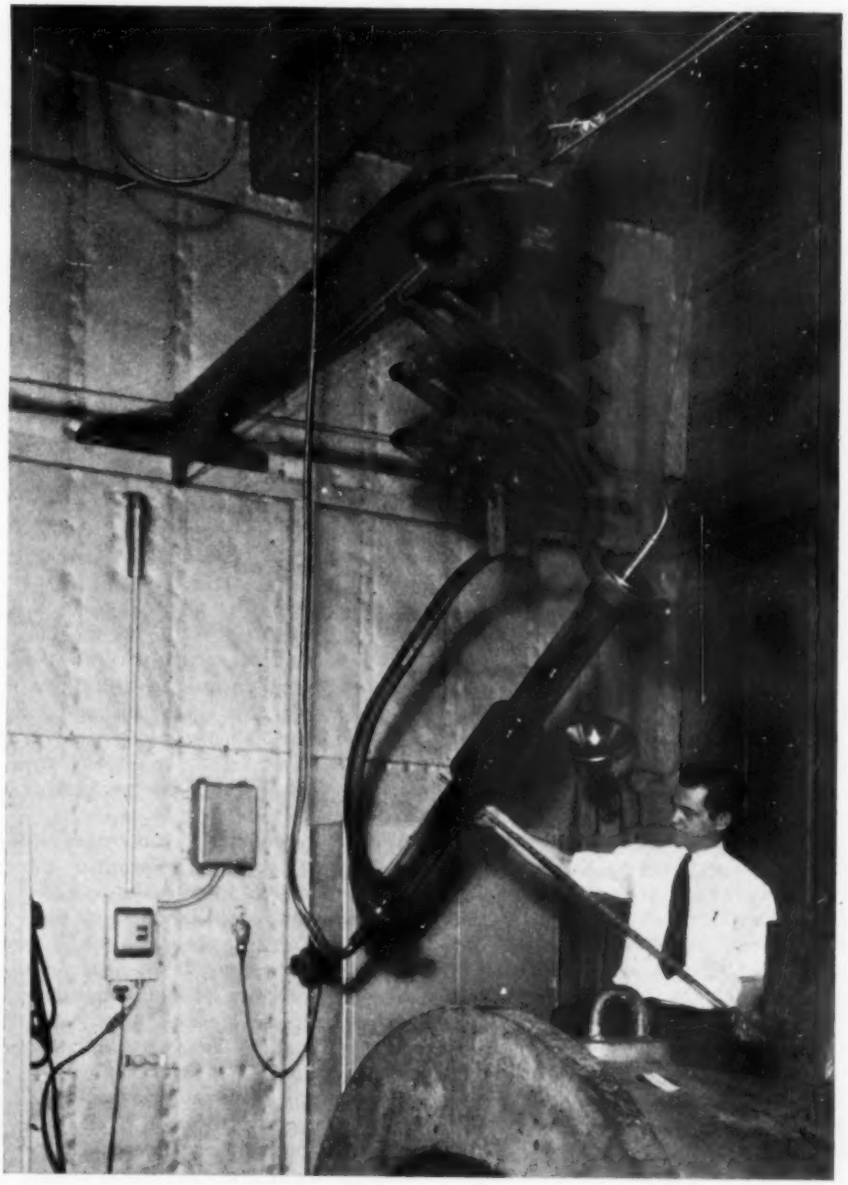


Fig. 1—This 400-kv. X-ray installation is employed for test plates more than 1½ in. thick, as well as for radiographing weldings and castings

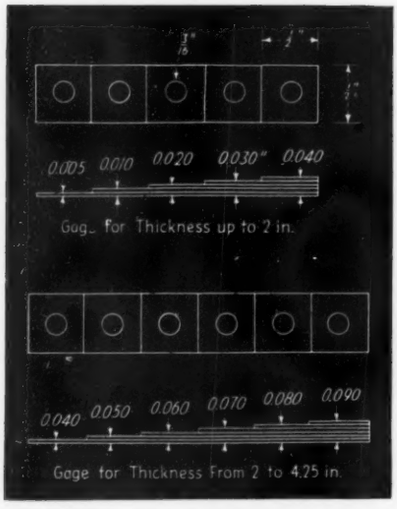


Fig. 2—Gages, such as these from the A.S.M.E. power boiler code, aid by proving that the radiograph has penetrated to the bottom of the weld

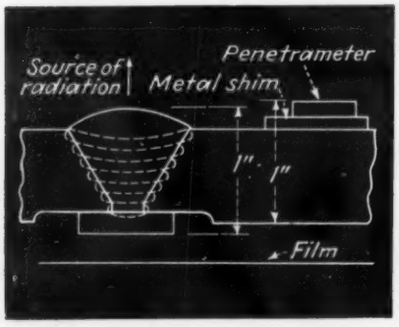


Fig. 3—Position of the penetrameter shown in Fig. 2 when making a radiograph is indicated in this sketch

an X-ray technique that is both fast and revealing. The radiograph of a plate brought to the laboratory can be viewed in about 15 minutes.

A number of factors contribute to the production of satisfactory radiographs. Very important are the screens and filters used. A screen is a cardboard support to which calcium tungstate has been fixed by means of a binder. This compound emits visible light when exposed to X-rays. X-ray film with emulsion on both sides is highly sensitive to visible light, so the effects of an exposure are speeded up when two screens are used, one on each side of the film. A filter is a metal foil, usually of 0.005-in. lead. It is used in the same manner as the intensifying screens, one in front and one in back of the film. The result is a fine grained image, less fogging from secondary radiation, and perhaps a slight intensification over no screens at all.

Our equipment is standard; we use the conventional intensifying screens

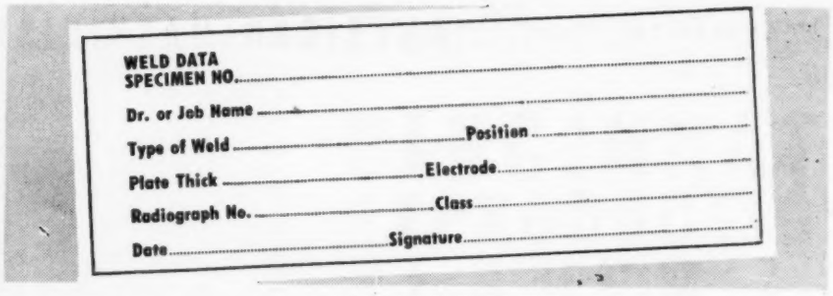


Fig. 4—Identification of radiographs of welds is secured by printing this form on the X-ray film during exposure

for flat work, and the old reliable lead filter screens for irregular shapes. Diligent care is taken to keep all screens clean and free from any marks which might print on the film. This means constant inspection of each type. It is necessary to keep intensifying screens free from dust particles or abrasions. Lead screens should be free from wrinkles, pressure marks and finger smudges. They also lose effectiveness with age, probably due to oxidation.

Proof of Penetration

One of the essentials of a finished radiograph is proof that one is "getting through" the weld. One way to do this is to create artificial defects of known depth on the surface of the weld and then look for them in the radiograph. This same effect may be accomplished by using gages such as are sketched in the A.S.M.E. power boiler code. In Fig. 2 are shown sketches from this code which indicate their application. This code for welding on pressure vessels requires that the final radiograph, to be acceptable, show a gage slot or hole with a depth of two per cent of the total thickness of the weld. The position of the gage relative to the source of radiation and the careful relation kept to the weld thickness is shown in Fig. 3. Technique used in the General Electric X-ray laboratory is such that definitions of one per cent or less are obtained.

So far as welding is concerned, the greater part of the X-ray work in the laboratory has to do with electrode development and application, and hundreds of such negatives are on file. The majority of these negatives have been taken stereoscopically. For these radiographs, the plates are about 14 in. wide, and have about 18-in. length of weld. This size is made necessary by the physical tests to be made later on the welds. Backing strips are removed from these test plates, and the irregularity of the weld surface is smoothed, as no surface imperfections can be allowed to interfere with the interpretation of the finished radiographs. A weld with this preparation could not be viewed successfully stereoscopically unless artificial identification of the top and bottom surfaces is provided. This is accomplished by taping lead shot close to the weld on both sides of the plate. These shot will register as white dots during exposure and serve as reference points in viewing the completed radiograph.

Two 14 x 17-in. cassettes equipped with intensifying screens are used as film holders for this job. These cassettes are made of metal and are constructed so that the screens make perfect contact with the film without excess pressure. The construction also distributes evenly any weight put on the cassette surface. The outside surfaces of these cassettes are ruled lengthwise for easy alignment of the welds. Identification of each weld is obtained in the dark room by proper positioning of three information slips on each film. These forms, Fig. 4, are filled out by the engineer, usually in pencil. When placed face down on the film in the intensifying screen cassette a permanent record is printed alongside each weld. The more translucent the paper from which these slips are made, the more clearly will the printing and writing show up on the film.

Flaws Located Stereoscopically

Using a generous backing of lead, usually $\frac{1}{8}$ in. thick, one of these cassettes is centered on the table. That part of the film reserved for the second and third welds is blocked out with a $\frac{1}{4}$-in. sheet of lead. The first plate can now be positioned for radiographing. Any part of the cassette not covered by the plate is shielded with lead. The gage with its necessary shims is taped to the surface of the plate, as is a lead letter R (indicating right-hand view). This helps identify the film for stereoscopic viewing. Care must be taken not to move the gage and the letters in handling the plates. The tube then is positioned to take this right-hand view. Records are consulted for the

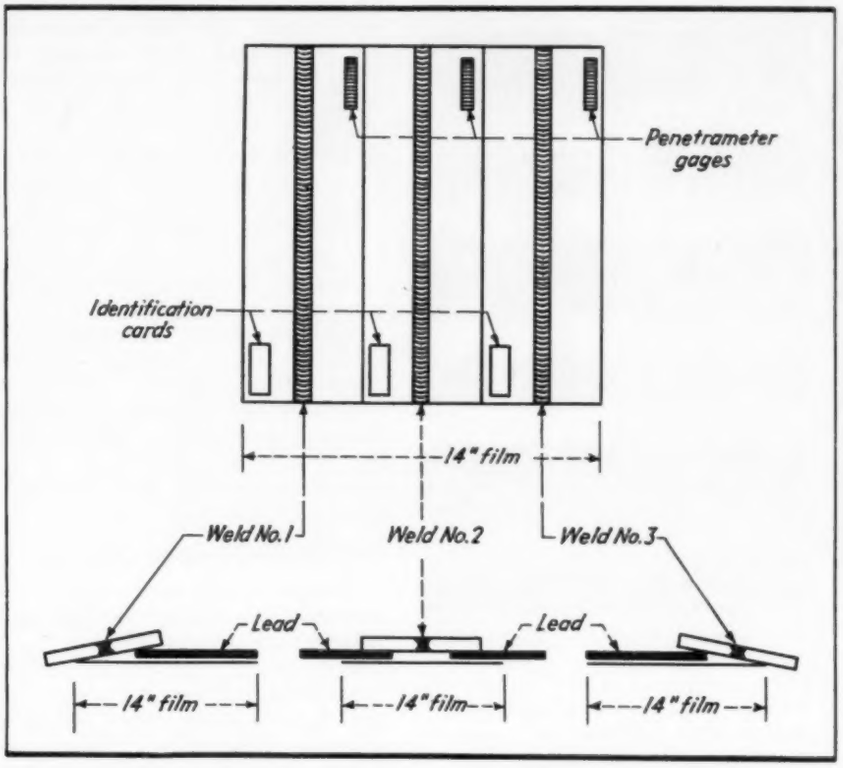


Fig. 5—Three successive radiographs of test welds are taken on a 14x17 in. film lead strips being used to shield film surfaces not covered by the test plate in each instance

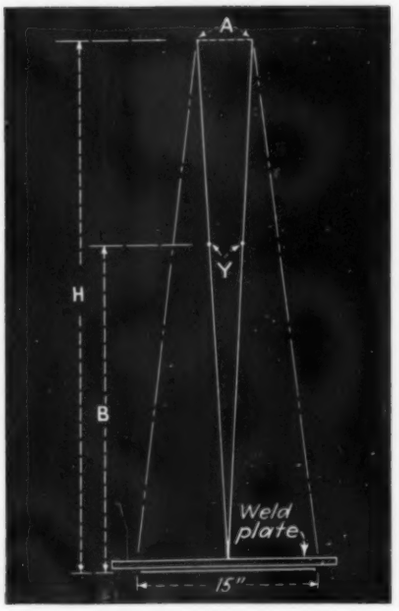


Fig. 6—The amount the tube is shifted between exposures for stereoscopic views is calculated from the formula $A = HY/B$ *in the above diagram*

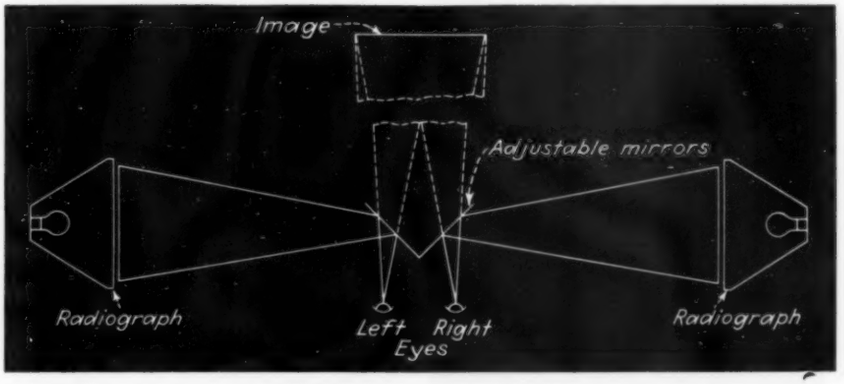


Fig. 7—Dotted lines in this diagram represent converging of flat views into a three-dimensional image in the Wheatstone stereoscope

correct exposure for each plate. The time of exposure is kept constant, and the voltage is varied for each $\frac{1}{16}$-in. change in thickness from weld to weld. Fig. 5 shows the handling of all three plates in completing half of the job.

This first radiograph is sufficient to define the soundness of the welds of these three plates but, in this instance, principal interest lies in ascertaining the exact location in the welds of any defects which may be present.

The advantage of stereoscopics over flat views more than offsets the slight increase in cost. To picture a weld stereoscopically, imagine looking at a defect in a piece of ice. The impression of depth is caused by each eye seeing the same view from a different angle. In taking radiographs of a weld for stereoscopic viewing, the X-ray tube is positioned and a radiograph is taken of the weld as one eye would see it. Then the tube is shifted and another picture is taken of the weld as the other eye would see it. Fig. 6 shows the derivation of this shift and its adaptability to any "source-to-film" distance.

In Fig. 6 where $Y = 2.5$ to 2.75 in., the average distance between a person's eyes, and $B = 25.0$ to 28.0 in. viewing distance in the Wheatstone stereoscope, $B/Y = H/A$. Here, $H =$ distance between film and X-ray tube, and $A =$ distance tube is shifted horizontally between the two exposures. Then, $A = HY/B$, and where Y is taken as 2.5 in. and B is 25 in., $A = 0.10\ H$.

The diagram in Fig. 7 indicates the method used when viewing radiographs in the Wheatstone stereoscope. The dotted lines represent the converging of the flat views into a three-dimensional image. The completion of the stereoscopic of the three weld plates necessitates the changing of the cassette for the second exposure, the shifting of the tube 4.2 in. across the center line of the cassette, and a duplication of the plate handling shown in Fig. 5. The laboratory uses a 42-in. distance between the X-ray tube and the film whenever possible.

Accurate Exposure Desirable

The development and fixing of films, although of a routine nature, is a very important part of the whole procedure. Good exposures can be ruined in the dark room by careless handling. The recommended practice of time-temperature development should be adhered to. In the G.E. laboratory, operators are taught that it is false economy to try to save an over-exposed film and that they will never be able to

obtain optimum results in X-ray work by juggling a piece of celluloid in the darkness. The use of the correct exposure and full development of the film produces such superior radiographs that the laboratory is amply compensated for an occasional wasted film. In addition, careful handling in fixing and washing reduces the chances of dark-room defects which often hinder interpretation, especially when films are sent away.

Before the films are dry, it is possible on a radiograph of a single V-groove weld to locate roughly any defects which may be present. If the radiograph shows porosity in a narrow band along the center of the weld it can be assumed that it is at the bottom of the weld. If, however, the porosity is spread out across the width of the weld, it is in the latter passes, or scattered all through the weld. Some of the other types of grooves do not lend themselves as readily to the above "wet" analysis. This information can be checked when the films are dry and are viewed in the stereoscope.

By using the white dots created by the lead shot previously put on the plates, it is easy to identify the top and bottom surfaces. By connecting these points with lines drawn on the films, the weld can be divided into planes, and a thorough study made of it in the stereoscope. This is very helpful, especially on multi-pass welds.

X-Rays Aid in Training

Fig. 8 is a picture of a set-up to handle small plates from the G.E. welding school. Such plates are sent to the laboratory with no expensive preparation for radiographing. The unusual features of these plates are their small size and the fact that they are welded with a wide backing bar. They are flame cut to about 3 x 6 in. to make it possible to radiograph several plates on 14 x 17-in. film in a single exposure. The wide backing strip provides a uniform section throughout the weld, thus permitting the use of fast screens, which are very sensitive to changes in thickness.

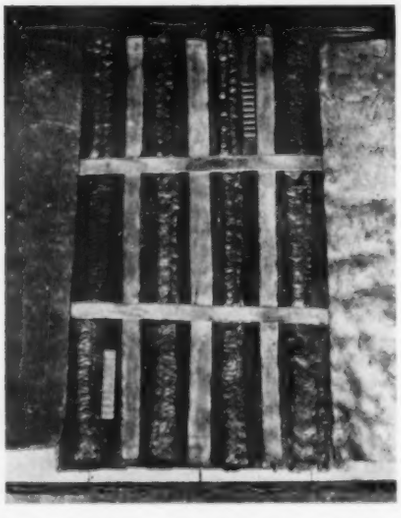


Fig. 8—Flame-cut 3x6-in. weld test plates from the welding school are X-rayed in groups to keep cost at a minimum

Then the combination of a narrow backing bar and ripples on the surface would result in a confusion of densities in the finished radiograph, and so greatly hinder interpretation. A number stamped on the backing bar by the welding operator at the time the plate is made readily is reproduced on the negative during exposure, thus providing identification for each plate.

As can be deduced, economy is the theme in this set-up. Since these pictures have no purpose other than to supply the welding instructor with information as to the progress of the students, low cost is essential. When a group of these plates is received, they are arranged quickly on a cassette. The over-all thickness usually is about 1 in., so the proper voltage is applied for 1 min. at the standard distance of 42 in., the film is developed, and the job is done. The largest item in the cost in this case is the film.

The qualifying of welding operators for certain jobs governed by codes or specifications indirectly is responsible for many weld plates reaching the X-ray laboratory. The welding operator is asked to demonstrate his ability by welding a test plate which is to be cut up and subjected to extensive physical tests. Although it is not a requirement, the welding supervisor often finds it expedient to radiograph these operators' plates.

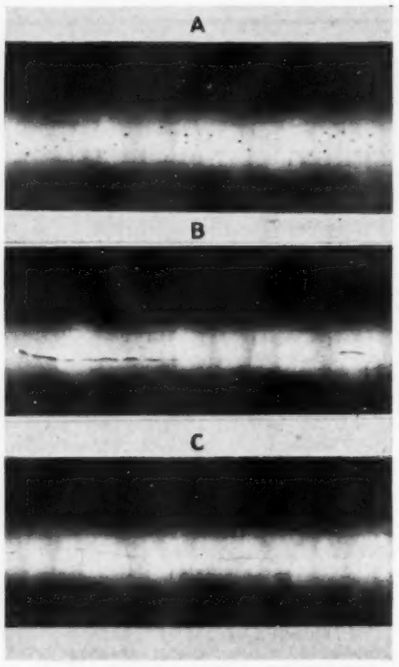


Fig. 9—Defects in welds fall into various classes. A radiograph of a porous weld is shown at A, *one indicating poor fusion or slag is shown at* B, *while at* C *are shown longitudinal cracks*

Another function of the laboratory is the occasional complete inspection of welded assemblies. Essentially, these assemblies are no different than test plates. The completed radiographs, when reviewed, enlighten the engineer, the welding supervisor, and the welding operator as to the success of his contribution in the production of a good welded product.

Different Defects Detected

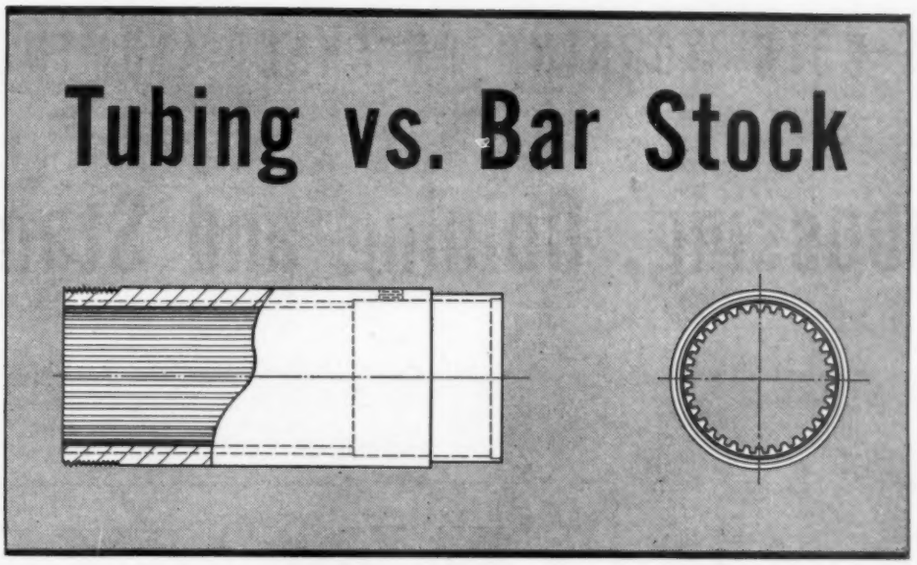
Defects found in welds fall into various classes. An attempt has been made to show three types of defects in Fig. 9. These pictures, however, are not true reproductions of weld radiographs, the defects being superimposed on the radiograph of a good weld. The reason for this is that much detail and contrast is lost in reproducing a weld radiograph for publication. As a result, the reader often is confused rather than informed. The defects shown were copied from radiographs held in the laboratory files.

Porosity can be recognized readily at *A* in Fig. 9, while poor fusion or slag is pictured at *B*. Longitudinal cracks are seldom found, but at *C* in Fig. 9 are shown longitudinal cracks purposely made by a welder with some effort. Incidentally, if the radiographic technique is poor, thin slag lines can be mistaken for cracks. Some standards list transverse cracks. The General Electric X-ray laboratory has never found any in a weld and ventures to state that they are probably very rare. Tears in metal adjacent to a weld are uncommon.

The very rigid supervision as to analysis of material and proper welding procedure undoubtedly are responsible for this.

The interpretation of weld radiographs relative to test plates has been made simple in the laboratory by a system of classification that enables much information to be written in a small space. This space may be found on the identification slip in Fig. 4 marked "class." In this system the homogeneity of the weld-metal is made dependent on what the X-ray will show. Any improvement made in radiographic technique calls for better welds to get the designation *NP-NS* (no porosity—no slag).

Tubing vs. Bar Stock



Seven separate savings were effected by changing from bar stock to tubing in machining this internally splined sleeve

BY HAL H. STROUSE, STEEL & TUBE DIVISION, TIMKEN ROLLER BEARING COMPANY

"What material shall we use?" This question raises a choice of form as well as kind. For certain products the use of tubing has distinct advantages

THERE ARE eight distinct ways in which a fabricator of machined parts can save if he uses seamless mechanical steel tubing in place of bar stock. Consider the case of a typical midwestern manufacturer making the internal splined sleeve illustrated.

When bar stock was replaced by tubing the spindle speed was increased from 90 to 115 surface ft. per min. Although 110 sec. per piece were required when bar stock was used, only 72 sec. were needed with tubing. Even though the potential output, using bar stock, was 261.6 pieces per 8-hr. shift, records showed that the best production ever obtained was 170 pieces, which represented only 65 per cent of the machine time, and 130 to 140 pieces were more frequent. Periodical shut-downs for drill regrinding accounted for the discrepancy between the potential and actual production. The potential production from tubing was 400 pieces per 8-hr. shift. Eighty per cent of the potential production, or 320 pieces, was realized.

Heavy drilling in bar stock slowed up the fabrication of this part and increased costs because drills burned. Considerable repairs were required because of the deep drilling operation. Repair costs were incurred when drill-lands wore down and caused undersized holes.

The drills themselves were a problem. High-speed, two-fluted oil hole twist drills, costing $27.68 per piece, had to be reground with a loss of $\frac{1}{8}$ to $\frac{1}{4}$ in. each time, two to four times a day. Three of these were discarded during an 1,100-piece run at a cost of $83.04. With tubing, three four-fluted core drills, costing $27.01 per piece, or $81.03, were used on an equal run. None was replaced and all three were in excellent condition at the end of the run.

The splined sleeves manufactured from bar stock became so hot that they had to be quenched in coolant before they could be plug-gaged, the temperature sometimes mounting to 130 F. or more. When tubing was used, the part could be taken off the machine with the bare hand, the temperature being in the neighborhood of 70 F. The wide difference in temperature was due largely to the fact that both the inside and the outside of the tube could be flooded with coolant. The more effective cooling was responsible for speeding up the spindle. A summary of comparative costs is given herewith.

	Bar Stock	*Tubes*
Cost of Material	$280.20	$238.20
Cost of Drills	83.04	Good Condition
Labor	75.00 (60 hr. at $1.25)	50.00 (40 hr. at $1.25)
Repair Cost	$25.00	None
	$463.24	$288.20

This example obviously illustrates seven of the eight advantages that may be realized in the use of tubing in place of bar stock.

1. *Heavy drilling was eliminated.* Expensive oil-hole drills were not needed on the tubing.
2. *Heat was reduced.* Temperature dropped from 130 F. to 70 F.
3. *Coolant was applied inside and out,* permitting the operator to handle parts without cooling.
4. *Surface speed was increased,* from 90 to 115 surface ft. per min.
5. *Drill life was increased.*
6. *More production was obtained.* Machine output on bars was 261.6 pieces per 8 hr. against 400 for tubing.
7. *Better size was obtained.* Tubing required no repairs due to under size holes.

An eighth factor did not enter into this application. On a more complicated job more operations per cycle can be performed with positions usually required for bar drilling.

Embossing, Coining and Stamping

J. F. WEINGIERL AND C. D. MYERS, ALUMINUM COMPANY OF AMERICA

These operations trace their heritage through a proud lineage. They add beauty to modern products, but new methods have greatly decreased their cost

EMBOSSING, coining and stamping are closely associated with the fine arts. They had their origin with the old masters whose creations were hammered into sheets of copper and of gold; with the engravers who incised their patterns into metal, stone and wood; and with the Roman slaves who were the motive power behind the colossal wooden mint machines whose stone negatives transformed gold slugs into Caesarian coins.

Today, these same arts are essential in strengthening, decorating, graduating and marking aluminum fabricated articles. The principles are identical, but the means of accomplishment are strictly modern, comprising the direct compression of metal between a punch and a die. Embodied in the direct compression methods most adaptable to sheet aluminum are embossing, coining, semi-coining and stamping. These operations are closely allied, and confusion often results when attempts are made to distinguish between them. Sketches shown in Fig. 12 have been prepared primarily to aid in a more adept classification, and to describe the peculiarities of each.

Embossing is the production of raised or projected figures or designs in relief on a surface, as at *A* and *B* in Fig. 12. At *A* is a section through a stiffening rib and the open die used to produce it. Simple operations of this kind require relatively light pressures and can hardly be placed in the direct compression group. Such embosses frequently are incorporated in drawing and forming operations. Fig. 12-B illustrates a more complicated emboss requiring the use of a closed die. Embosses of this kind are definitely within the direct compression group and require comparatively high pressures to produce clearcut outlines. Note that the thickness of stock is consistent throughout the section—the only factors causing a possible deviation being the mild stresses due to bending and stretching. It may be said that this uniformity of thickness is the identifying characteristic of the emboss.

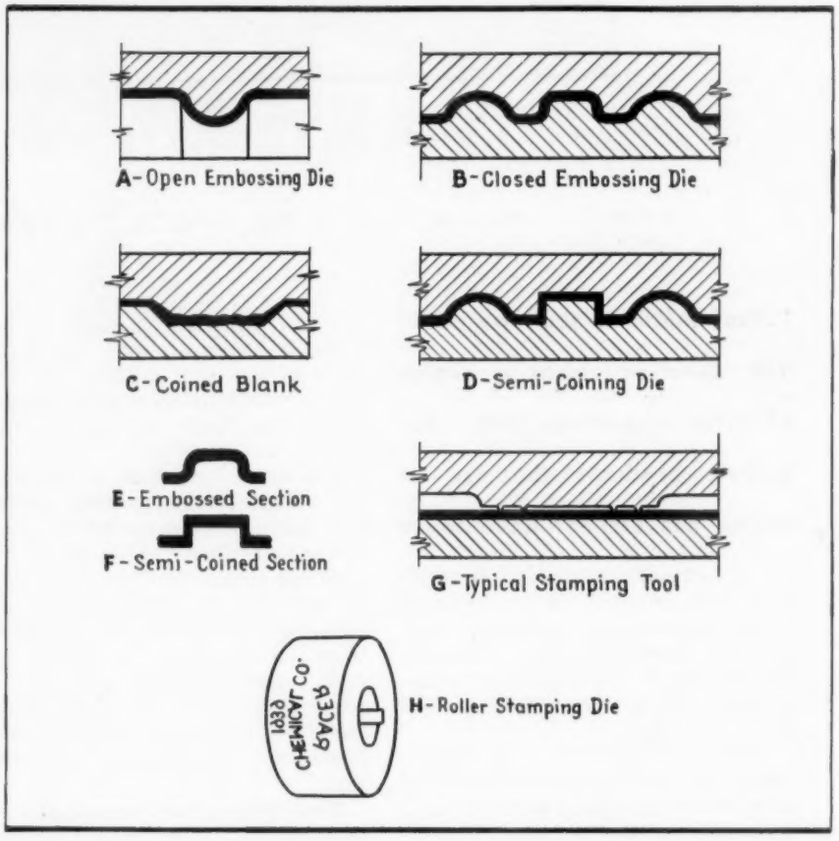


Fig. 12—Typical compression operations discussed in this article. Press tools for work of this nature are of simple construction. Controlling factors are the malleability and ductility of the metal being worked

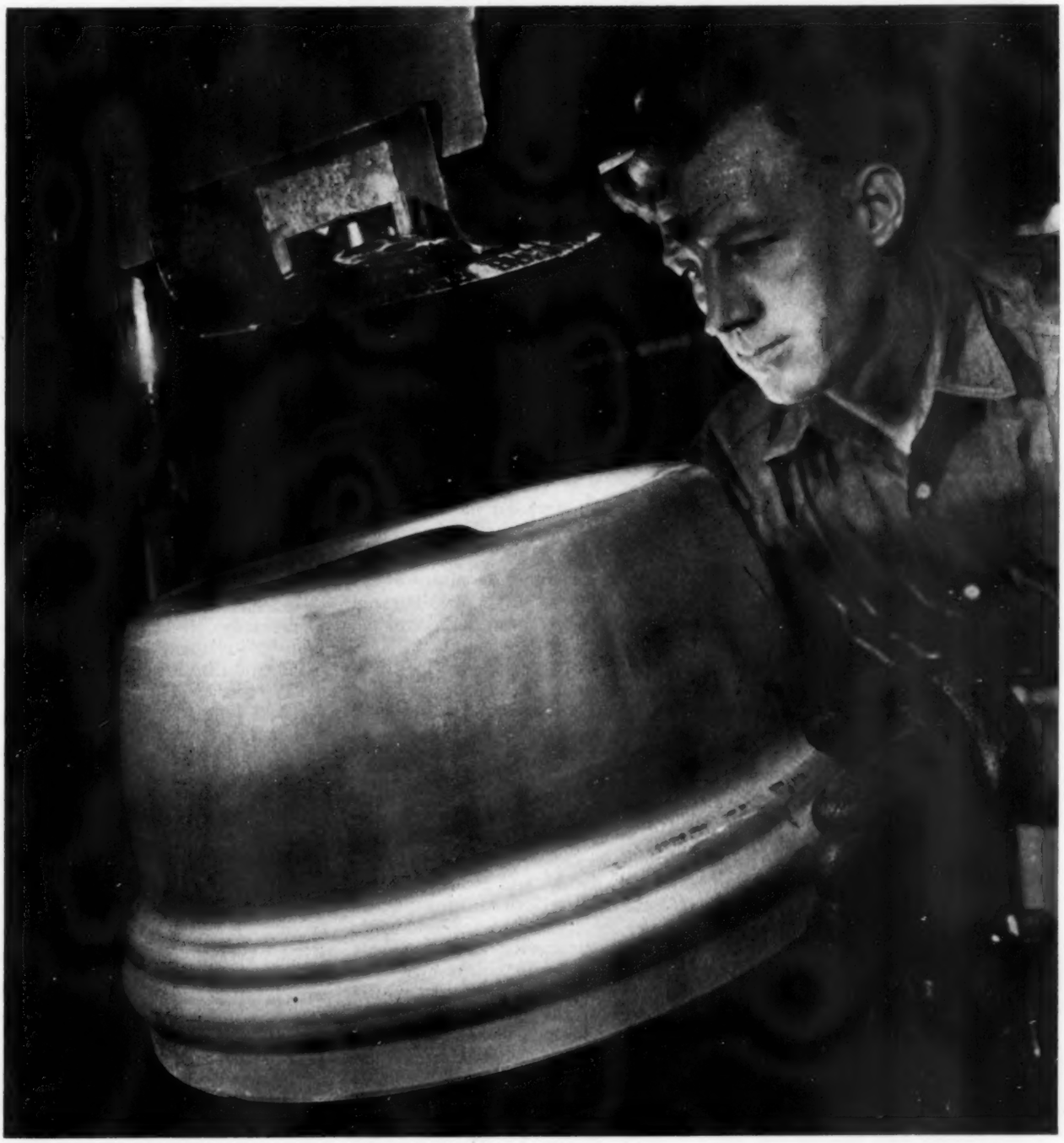
The use of rubber to supplant the steel female embossing die has proved practical in many instances. The decoration of aluminum foil by passing it between a steel roll having the desired design cut in relief upon its periphery and a smooth rubber-faced contacting roll, is but one example of its successful application.

Coining is a method by which the images or characters on a set of molds are impressed into the plane surfaces of a blank or a disk. At *C* in Fig. 12

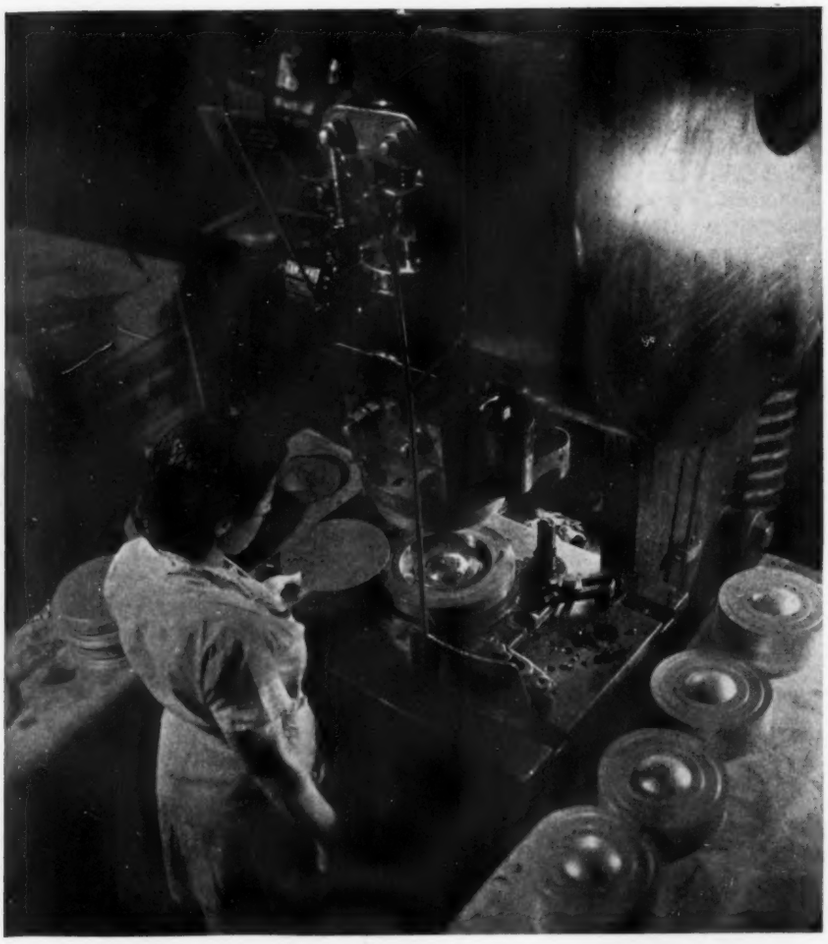
is an example of a coined blank showing how the metal flows between the punch and the die and assumes a contour negative to that of the two faces. In the type of die shown, clearance is allowed for any flash that might occur around the circumference of the blank; when a completely closed die is used, danger may be encountered by overgauge blanks and the accidental feeding of double blanks. As a precautionary measure, such dies are often mounted on hydro-pneumatic pressure equalizing cushions.

Semi-coining is a combination of embossing and coining. It is a mechanical means of doing the work of the hand chaser by causing metal to flow from one part of the emboss to another. The die shown at *D* in Fig. 12 is representative of such an operation and is the same in all respects as the die at *B* except that the center emboss has a sharp profile. At *E* and *F* are enlarged sections which permit better analysis. It can be readily seen that the vertical side-walls of section *F* are much thinner than those of section *E*. This is the result of a negative clearance between the punch and die, causing them to pinch at this point. The metal thus displaced is of sufficient volume to fill completely the sharp corners of the punch and die and produce the desired profile.

It is important that the tools and



A 300-ton hydraulic press is used for stamping the brewer's name on the upper half of a drawn 15.5-gal. aluminum-alloy beer barrel. The steel letters are set in the holder in the same manner as printer's type



This single-action press combines embossing and drawing in one operation. The shallow dome in the center is drawn while the rim is embossed

blanks for coining and embossing be kept free from foreign substances. The use of oil or other lubricant should be avoided. However, it has been found that in some classes of coining, the use of alcohol or other light lubricant is beneficial.

Stamping refers to the cut lines of letters, figures, and decorations resulting from the impact of a stamp having a comparatively sharp projecting outline upon a smooth surface. At *G* in Fig. 12 is a cross section of a typical stamping tool. Stamps such as that shown are usually cut to a depth of from 0.020 to 0.040 in.

The press tools for embossing, coining and stamping are of simple construction. The usual tool consists of a punch and die which are mounted respectively on a punch holder and a die shoe. Except in stamping tools, it is always advisable to use a die set equipped with leader pins, in order to insure proper alignment of the punch and the die. In all coining and embossing tools, the punches and dies serve as forms for producing the desired designs. Aluminum being a comparatively soft metal, the impact of the press will cause it to flow into any minute imperfection in the face of the punch and die; it is important, therefore, that these parts be kept perfectly smooth and polished. Both the punch and the die should be made of a good grade of tool steel, and hardened so as to better resist the excessive wear to which they are subjected.

In the case of stamping tools, only the punch, on which the desired figure has been cut in relief, is hardened. The die—more correctly defined as the anvil—is smooth and usually made of a mild steel. Horn or single-action presses are often used for light types of work. Frequently the stamping of numerals, trademarks, names, and the like, is effectively and economically combined with other manufacturing operations, such as drawing, forming, and embossing. Stamps for such use are precisely made, and the depth is controlled by the use of shims of suitable thicknesses underneath the stamps.

Roller dies provide a very practical method for stamping. The sketch at *H* in Fig. 12 illustrates a roller die used in a marking machine. In flat stamping, the roll is driven over the stationary article and the "marking" is rolled into the surface. Similar stamps are used when the operation of marking cylindrical work is performed in a lathe or similar machine.

In stamping, the depth of penetration should be carefully observed. To prevent distortion and to keep the design from "showing through" on the stamped article, outline or open-faced stamps should be given preference as they do not displace as much metal as the broad-faced stamp.

Special knuckle-joint presses are built for coining and embossing. These machines are of rigid construction and take greater loads in proportion to their weight than any other press. They have short strokes and are designed so that the mechanical advantage of the knuckle joint results in intense pressures during the last portion of the stroke. Precision adjustment of the tool space is provided.

Controlling factors in the coining and embossing of aluminum, so far as the metal is concerned, are its malleability and its ductility. The former is its characteristic to yield to compressions and impacts and the latter is a qualitative term referring to elongation produced by tension.

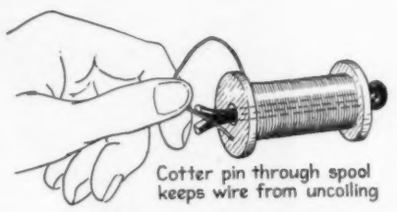
Within certain limitations, when a deforming force is removed from a piece of aluminum it will regain its former shape. When this limit is passed, the metal takes a permanent set or only partially recovers. If, however, the deforming force is increased so as to produce a progressive deformation, then fracture will eventually result. It is the range, therefore, between the limit of elasticity, which must be passed and the ultimate strength which must not be exceeded, that constitutes the field for embossing.

Aluminum sheet is available in a variety of degrees of hardness from "dead soft" to "hard." Since temper affects its resiliency, or ability to absorb shock without permanent deformation, it is only logical that the "dead soft" or intermediate tempers such as "¼H" and "½H," or "W" in the case of heat-treated alloys, are preferable for embossing. A good rule to follow is to select a grade and temper with as high elongation and as low a ratio of yield strength to tensile strength as possible, consistent with the properties required by service conditions.

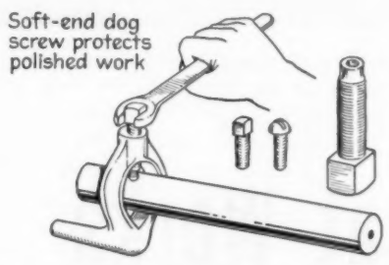
For decorative purposes, the stamped or embossed piece can be given a variety of finishes to enhance its appearance. The finish may also contribute other salient characteristics, such as improved or lowered reflectivity and resistance to corrosion and abrasion.

SHORT CUTS FOR THE SMALL SHOP

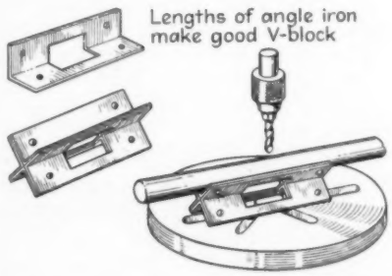
BY A. H. WAYCHOFF



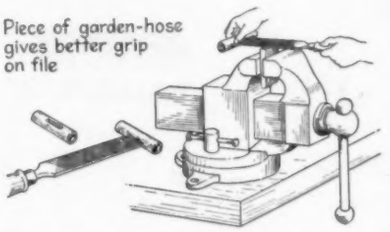
UNCOILING and tangling of wire stored on spools can easily be prevented by this simple trick. Just push a long cotter pin through the hole in the spool, spread the ends apart slightly, and force the loose end of the wire between them. The pin keeps the wire from uncoiling and the wire keeps the pin from falling out.



POLISHED or highly finished work can be turned without danger of marring with this altered lathe dog. Drill and tap the inner end of the dog screw, and into it screw a brass machine or cap screw. When the dog is clamped on the work it will hold almost as well as it did originally, and will drive the work without scratching. The soft-head screw can easily be replaced when worn.

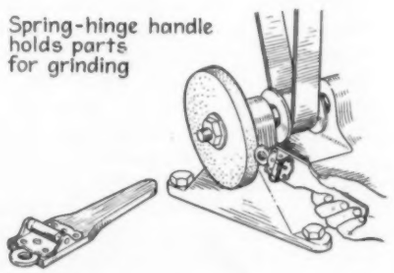


LITTLE work and no expense is necessary to make this handy V-block. All that's needed are a few scraps of angle iron and some rivets. Cut four lengths of angle iron to the length of the finished block, then cut out a section of each as shown in the sketch. Four holes drilled accurately in the sides of each piece, and the block is ready for riveting. The holes can be countersunk and the rivets finished off flush if desired. This makes a fine block for the drill press, as the drill can pass right on through the opening in the center.

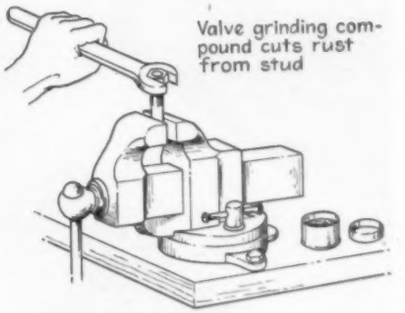


INSTEAD of getting your hand sore or blistered when filing for a long time, use a scrap of garden hose for a comfortable hand rest. Slit one side a little more than the width of the file and then hammer it onto the file in the position shown. It will stay in place throughout the hardest use, yet is easy to remove instantly.

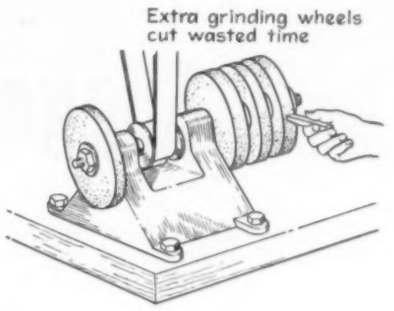
FILING is a mighty good method for getting lots of things to fit just right, but some times you want to be sure of filing on one side of a cut only. To make sure of this, slip a piece of flat telescoping curtain rod over the file, with the sides gripping the file edges. This way only the bottom of the file can cut, so there's no danger of the top or sides taking off metal when they're not supposed to.



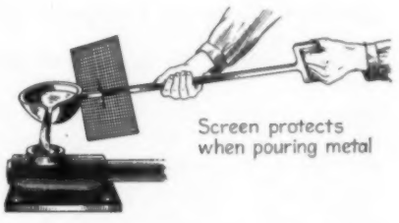
GRINDING small objects has always been somewhat of a problem because of the difficulty of holding them. One good way is to screw a spring hinge, of the type used on screen doors, to the end of a sort of paddle. It will hold firmly small pieces of flat sheet metal, and the handle makes accurate grinding easy.



REASSEMBLING an automobile engine or other piece of machinery that takes a lot of abuse is often harder than taking it apart, on account of the rust all over everything. A good scheme for studs and bolts that have to be turned up tight is to daub some valve grinding compound on them and run a nut over them a few times. This will clean off all traces of rust, and will eliminate any danger of locked threads and twisting off.



IT'S NO trick at all to mount a couple of extra polishing wheels on the same arbor, and it saves a lot of time when many parts have to be rough ground, polished and buffed. A washer or two between them will keep them apart. The coarse wheel, which has to stand the most pressure, should be on the inside.



DANGER of injury from blowups when pouring metal can be reduced by forcing a large square of scrap window screening over the ladle handle. When pouring, you can still see through the screen, but molten metal won't fly through it.

Two-compartment boxes are placed throughout the shop so that any employee can place his suggestion in the top and a slip showing his name in the bottom

A Suggestion Plan That Works

BY CLIFFORD E. STUBBS

Many a good idea dies aborning just because a man in a minor position thinks his advice is not wanted. Here is what the Bryant Chucking Grinder Company did to turn ideas to practical use

THE SUCCESS of any suggestion plan is dependent upon a spirit of good will between management and employees. The reason is obvious. If cooperation is not there at the beginning, suggestions may be submitted as anonymous criticisms of employer, or the refusal of the management to accept a suggestion may lead to bitterness on the part of the suggestor. The men in the shop must realize that many of the direct benefits are theirs; that the plan is being started for just one reason, that is to reduce costs either directly or indirectly.

Benefits to the employees are many. Their suggestions bring about better working conditions, they receive remuneration for each suggestion accepted, increases in pay often are a direct result of ideas becoming known, and suggestions frequently serve as proof of mechanical and executive ability when an employee is being considered for advancement in position. Although these same benefits may be had without a suggestion plan, it has been proved that such a plan stimulates thought and accomplishes these benefits in less time than if no suggestion plan were employed.

At the start, the Bryant Chucking Grinder Company decided to use a *continuous* type of plan, rather than a *contest* type. It was felt that a continuous plan would have more far-reaching effects, as it would lead to more accurate results in determining actual worth of a man than would occasional contests. It also was determined most practical to leave the suggestion plan open only to the men in the shop, excluding foremen and others in executive capacities.

At the beginning a printed form was inserted in all pay envelopes, explaining the use to which those suggestions would be put and the benefits that might be expected from any usable ideas. This same form also is given to any new man entering the employ of the company.

Suggestion slip boxes, like that shown in the accompanying photograph, are located at various places throughout the plant. These boxes are divided into two compartments. In

SUGGESTION PLAN

"We are putting into operation a plan making it possible for everyone to contribute toward the continued improvement of our business efficiency.

"Printed forms are available which are to be used for ideas and suggestions of all kinds relating to the work of the designing, manufacturing and distribution of our machines.

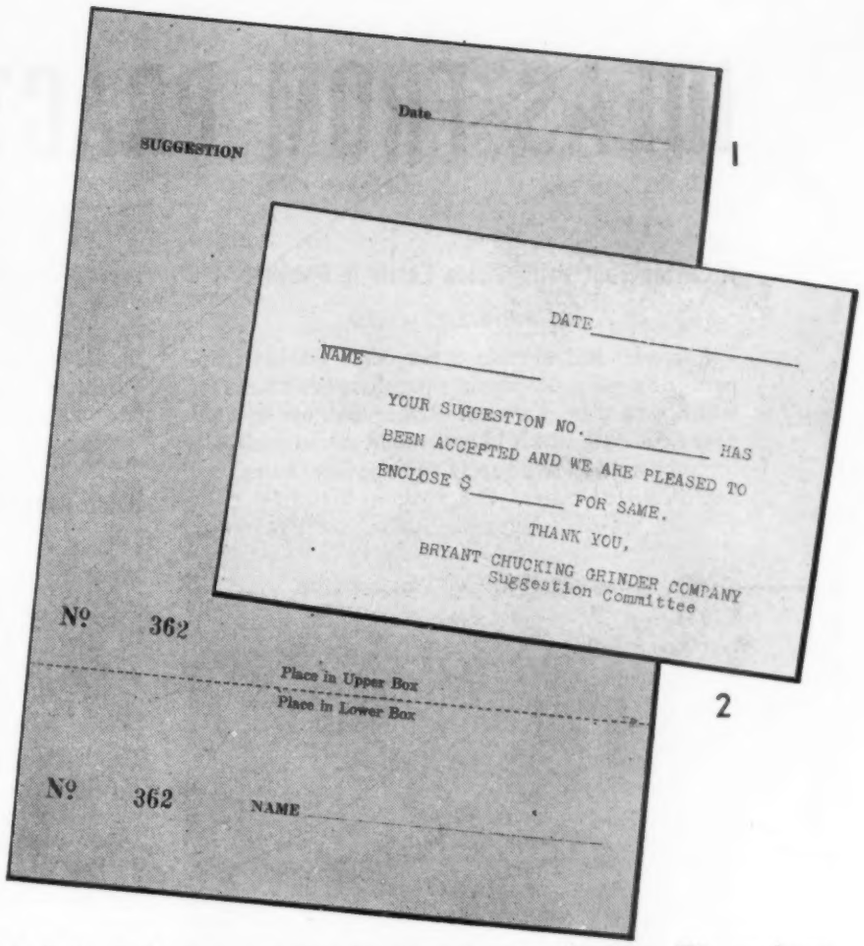
"These suggestions will be judged monthly by a committee. Those accepted will be compensated for by from $1.00 to $5.00 for each idea, whether or not the idea is eventually put into practice.

"From the form it will be understood that the judgment of the committee will not be influenced by identification of the individual making the suggestion. All ideas will be considered confidential by the committee. We will try to guard against any partiality in the operation of this scheme and will be ready to revise it whenever injustices become evident.

"If the same suggestion is made simultaneously by more than one individual, the compensation will be split. If a rejected suggestion is used at some later date, the individual concerned will receive his due compensation by bringing it to the attention of the committee. All suggestions will be filed permanently.

"The company will welcome every well-meaning suggestion, whether or not it is judged acceptable and will expect to explain all rejections. We hope that every member of the organization will feel interested in using this means to contribute to the further success of the company."

BRYANT CHUCKING GRINDER COMPANY



1. Pads of this form are placed near each suggestion box. The employee writes his suggestion in the upper part of the form and his name on the lower section, then tears them apart and places the sections in the upper and lower compartments of the box

2. When a suggestion has been accepted by the committee, the award and this form are placed in the next pay envelope of the employee responsible for the suggestion

the upper section of the locked box is placed the suggestion, and in the lower section the name of the man making the suggestion. The two parts of the suggestion are keyed with a number. The judging committee, working only with the suggestion slips placed in the top compartment of the box, does not know who has made a suggestion until a decision has been reached on whether the suggestion should be accepted or rejected.

Once a month the suggestion slips are collected from the upper section of the box. Then they are sorted under the following classifications: factory, engineering and sales. Each of these departments is represented by a member on the judging committee, and it is the duty of the representative from each department to sort over the slips concerning his own department and study the practicability of each suggestion before the judging committee meets.

At its meeting, the judging committee discusses thoroughly the possibilities of each suggestion. After all the ideas have been judged, awards are decided upon for those ideas which are acceptable. The two parts of the suggestion slip then are matched according to their numbers so that the name of the suggestor may be learned.

When this has been done, the amount of the award and a "thank you" note are placed in the next pay envelope of all men whose ideas have been accepted. The amount of the awards and the numbers from the suggestion slips then are posted on the shop bulletin board. The plant superintendent is charged with the responsibility of going to all suggestors whose ideas were rejected, and giving a full explanation of why this was done.

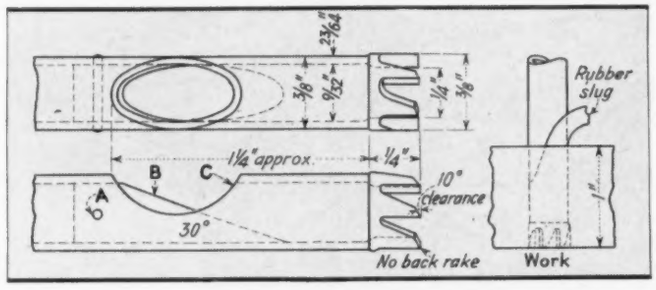
Although the awards were originally established within the limits of $1 to $5 for each acceptable idea, no maximum is set for ideas which, in the mind of the judging committee have unusual and lasting merit. Many suggestions, of course, have a limited value because of the nature of the work done in a machine tool plant. In other words, ideas for engineering changes might have come out of the engineering department a few months or even days after the suggestion is made in the shop. Also, a suggestion for a change in a machining operation might apply only to a machine which will be obsolete within a short time. For this reason, the company has found it most practical for the shop superintendent to explain in detail why a suggestion was accepted or rejected and how the judging committee arrived at the award given in each case.

IDEAS FROM PRACTICAL MEN

A Cutter That Drills Holes Easily in Rubber

BY ARTHUR R. MYERS

I recently had to make a number of rubber strippers for a gang of piercing punches, the shanks of which were $\frac{3}{8}$ in. diameter. Rather than use an ordinary twist drill, which I knew would thread itself into the rubber and leave hardly any opening, I designed the illustrated cutter. Other cutters could be made for different sized holes, simply by making the hole



Holes can be drilled easily in rubber with this tool. The hole back of the cutting edge should be 1/32 in. larger than the inside diameter of the cutting edge to permit the free passage of slugs

in the cutting end of the tool the same size as the hole wanted in the rubber.

The tool shown in the drawing was made for drilling rubber 1 in. thick, but I have successfully used it for drilling rubber $1\frac{1}{2}$ in. thick; the slug seems to compress enough for the cutter to pass through this additional thickness. The cutter was made from a piece of $\frac{3}{8}$-in. drill rod 4 in. long. After drilling a $\frac{1}{4}$-in. hole through the center of the rod, it was turned end for end in the collet and redrilled to within $\frac{1}{4}$ in. of the end with a $\frac{9}{32}$ in. drill. The drill rod had been turned to exactly $\frac{3}{8}$ in. outside diameter for a distance of $\frac{1}{4}$ in. from the cutting edge. The remainder of the drill rod was turned to $\frac{23}{64}$ in., this relief being used to reduce friction of the cutter as it penetrates the rubber. The cutter flutes were then made with no back rake and a clearance angle of 10 deg. Opening *C* was then filed to a depth of approximately $\frac{1}{2}$ of the diameter of the cutter. The piece *B* intended to guide the rubber slug out of the opening *C* is made of $\frac{9}{32}$ in. drill rod and pinned to the cutter at *A*. The ejector *B* was pinned in place after the cutter was hardened and tempered.

The location of opening *C* and ejector *B* depends upon the thickness of rubber to be drilled. It is advisable to keep the wall thickness of the cutter as thin as possible and still have enough strength to resist breakage. It is surprising how easily this cutter passes through the rubber. The material can be held by hand without any tendency for the cutter to grip the rubber and cause it to spin. It is advisable to use a light lubricating oil this reduces friction and facilitates removal of the slug.

Holes Punched in Saws of High-Speed Steel

By W. O. DOWNS

We recently changed over a metal-cutting disk saw from a sprocket drive to a worm drive. There were six sprocket-drive disk saws of high-speed steel, $\frac{11}{32}$ in. thick and varying from 36 to 40 in. diameter. Each of these had to be punched with four $\frac{3}{4}$-in. holes on 12 in. centers without warping or softening the steel. The holes were made as follows:

A $\frac{1}{2}$-in. steel plate 8 in. in diameter was prepared with a $\frac{3}{4}$-in. hole in the center. This plate was placed on the saw with the hole located above the point on the saw where a hole had to be punched. The plate and saw were held in a radial crane adjacent to a heavy-duty punch, and raised to a convenient height where a hole could be cut in the saw with an oxyacetylene torch. Excess heat from the cutting torch was conducted away from the saw by the $\frac{1}{2}$-in. steel plate, but sufficient heat was concentrated on the saw to flame cut an irregular hole throughout the high-speed steel in a few seconds. The ragged edge in the saw was then brought to a red heat without causing the saw to warp or soften beyond the area which was to be punched. The saw and plate were then swung under the heavy-duty punch, and the punch lowered through the hole in the plate. When the punch penetrated through the irregular opening, it left a smooth hole.

Speeds Repairs to Water Columns and Gage Cocks

By A. H. CARROLL

It is compulsory in all locomotive shops and enginehouses to clean out water columns and gage cocks at regular intervals. In some instances this requires no added effort or special tools other than an ordinary drill welded to a crank or fastened in a brace. However, due to the misalignment of the holes in joining parts, it is often impossible to get a drill of the correct size through the holes that have accumulated a deposit of scale. Consequently, the gage cock and water column are reamed with the largest possible drill and may be allowed to go back into service with a light deposit of scale still in the bodies of the valves.

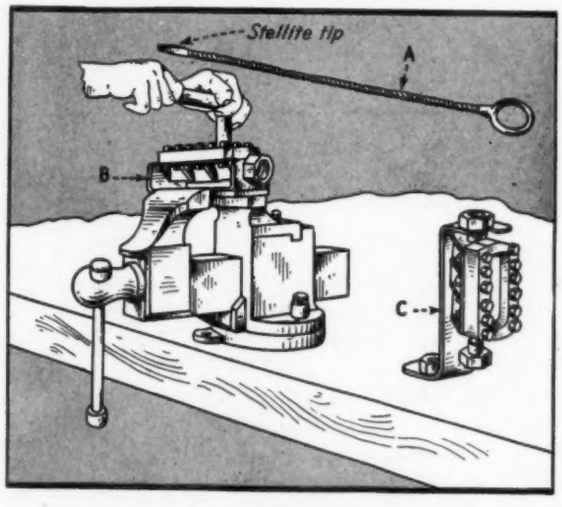
A tool that winds itself into these difficult places

and cleans them thoroughly is shown at *A* in the drawing. It is both flexible and durable. To make the tool, take a number of strands of galvanized wire of the type used to apply dry lagging to the boiler and bend them double over a piece of ½-in. round steel about 1 ft. long. Gather the loose ends and fasten them in a vise. By turning the ½-in. rod end for end the wires are twisted together forming a flexible cable. The loose ends are cut off square with a sharp chisel and this end is built up with Stellite. The amount of Stellite varies with the size of the drill but should be large enough to grind into a stubby square drill about 0.0010 in. under the size of the hole in the valve body it is going to ream out. The proper length is then determined and the remainder of the cable cut off. To this end is welded or brazed a ring or T-handle.

Many brass bodies of water glasses are relegated to the scrap heap because a careless mechanic tightens the vise too tight when he is working on the glass. To prevent this I devised the holder *B*. The holder is made from tank steel $\frac{3}{16}$ in. thick by 3½ in. wide. The base is 10 in. long with a 2-in. flange on each end. A slot about 1 in. square is cut in each flange near the center, and a piece of ¼ x 3½ x 10-in. steel is welded to the back to afford a good vise grip.

When working on the glass it is placed in the slots cut for this purpose. The water glass is held securely and saves much time when contrary bolts need holding, for with this holder the glass can be turned on its side and still be held securely.

Holder *C* is similar to *B* but has one end turned backwards. This is tacked to the bench as shown. Here the completed glass is held upright while graphite is applied to the union nuts and the tapered portion near the glass is painted a bright red to make the water more readily discernible.



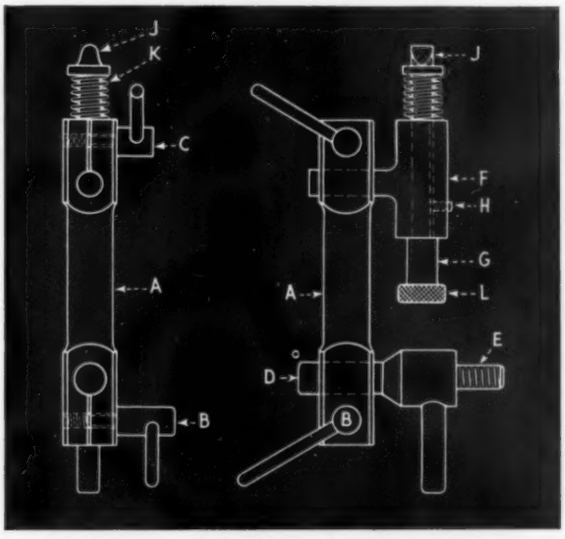
A number of strands of galvanized wire twisted and tipped with Stellite makes a convenient tool for cleaning holes in gage cocks and water columns. Damage to the water columns during repairs can be prevented by holding them in straps made of tank steel

Simple Attachment for Lathe Indexing

By GEORGE C. LAWRENCE

The illustration shows a simple and inexpensive set-up for indexing work in the lathe. The bar *A* is slotted at bond ends, and drilled and tapped for the clamping screws *B* and *C*. Bar *A* is carried on the stud *D* which is threaded at E to fit the tapped hole in the swing plate at the rear end of the headstock. Sleeve *F* is carried at the other end of *A* and clamped by *C*.

The index pin *G* slides in *F* and is splined and held from turning by setscrew *H* which fits this spline. Pin *G* is shaped at *J* to fit the tooth spaces of the gear selected for indexing, this gear being held on the rear



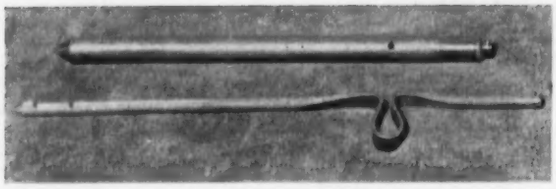
This indexing set-up was designed for the lathe when using milling or grinding attachments on work held in a chuck or on centers

end of the spindle in the usual way. The index pin is held firmly in contact with the gear by spring *K*, bearing against a shoulder on pin *G* as shown. The pin *G* is disengaged from the gear by the knurled knob *L* for the next indexing.

Indicator Adapter Made From Drill Rod

By H. R. HAGEMAN

Most diemakers will recognize the tool shown at the top of the illustration as an arbor or adapter for centering a prick-punched job on a lathe faceplate with the aid of an indicator. The other tool is much simpler in construction and is used in the same manner except that the unpointed end is held in a drill chuck instead of being supported by the lathe center. It is made of $\frac{3}{16}$-in. drill rod with a short section flattened and bent into a loop to provide the spring necessary to prevent the point of the tool slipping out of the punch indentation. Because of the small diameter of the rod, a flat is ground near the point to



A flattened piece of drill rod with a bent loop to serve as a spring makes a satisfactory indicator adapter. The unpointed end is held in a drill chuck instead of being supported by the lathe chuck instead of being supported in the usual manner by the lathe center

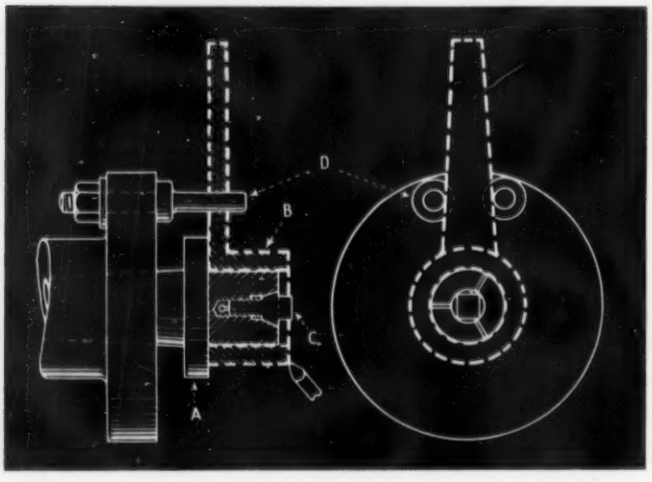
afford a suitable bearing point for the indicator finger.

The indicator method of centering has at least one advantage over the wiggler method, for example, if it is required to bore the hole a few thousandths off to one side of the punch mark the job can be located precisely by the indicator method but not by the use of a wiggler.

Suggested Method for Facing Lever Hubs

BY ARTHUR SILVESTER

For turning and facing a large quantity of levers after they had been bored, H. Moore (*AM*—Vol. 84, page 584) suggested that two levers could be mounted on a mandrel and spaced with a slotted



This expanding mandrel, with a case hardened surface to fit the bored lever hub, is sufficiently rigid to turn and face the hub. The overhanging lever arm is not a deterring factor, even at high rotative cutting speeds

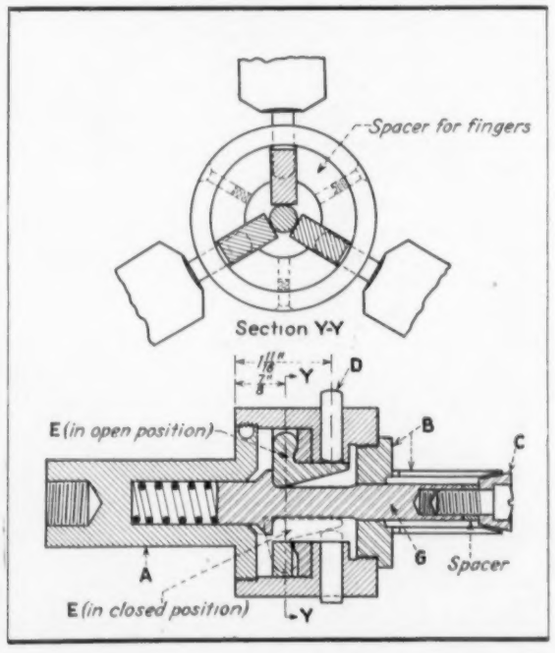
sleeve, thus balancing the work at high rotative speeds. The sleeve and levers were held on the mandrel by set screws.

I do not see any advantage in using this set-up. The expanding arbor *A* shown in the illustration is satisfactory for turning and facing the lever hub *B*, and eliminates the use of the tailstock. The arbor *A* was split in three places 120 deg. apart. It was drilled, tapped and tapered to take the $\frac{3}{4}$-in. special stud *C* the taper on the head of which fits that in the end of the arbor. This stud was milled with a square end for a wrench fit. The face of the arbor, on which the bored lever hub was placed, was case-hardened and ground for a sliding fit on the hub. An extra hole was drilled in the faceplate for pin *D*.

Chuck Operates Expanding Mandrel

BY FRANK C. HUDSON

Time is saved in the shop of W. F. Curlee Manufacturing Company by utilizing the advantages of a Foster-Baker wrenchless chuck to operate an expanding mandrel. Shank *A* is a snug fit in the chuck bore



This expanding mandrel was designed for threading and chamfering malleable iron fittings. Production is 65 pieces per hour

and is held in place by a $\frac{3}{4}$-in. draw bolt. Several sets of collets *B* are provided to hold work of different sizes. Each size requires a suitable expanding cone *C*.

The collet holder is secured so that pins *D*, which are $\frac{3}{8}$-in. drill rod, are under the chuck jaws. When the jaws are closed the pins act on bell cranks *E* and force the control rod *G* to the left, expanding the collet into the work. On releasing the chuck jaws a spring behind *G* forces it to the right and releases the work.

This device is so efficient that 65 fittings of $1\frac{1}{2}$ in. diameter can be threaded and chamfered per hour. The same idea can be adapted to other similar parts.

Armament

SECTION OF AMERICAN MACHINIST

TOOLING SET-UPS FOR HIGH EXPLOSIVE SHELL—III

By BEN C. BROSHEER

Associate Editor, American Machinist

FINISH-TURNING operations on shell done in Lodge & Shipley No. 3 Duomatic lathes have been laid out to follow nose machining operations, except that the nose is not to be threaded when the shell is delivered to the finish-turning machine. In the tooling layout for finish-turning a 75-mm. shell on a No. 3A×27-in. Duomatic lathe in Fig. 62, the two tools on the front carriage form turn the ogive at *A* and taper-turn the boat-tail at *D*. At the same time the two tools on the back carriage finish turn the straight section *C* back of the bourrelet, and finish-turn the bourrelet at *B*. The three-segment expanding arbor fitted to the spindle of this machine is actuated by an air cylinder at the other end of the spindle. Set-ups of this nature have been made with high-speed steel and carbide-tipped tools, cutting speeds and feeds being dependent upon the tool material selected.

Form turning is done with both the front and the rear carriages when a No. 3A×27-in. Duomatic lathe is set up as shown in Fig. 63, for finish-turning a 90-mm. high explosive shell. Here, the ogive *E* is

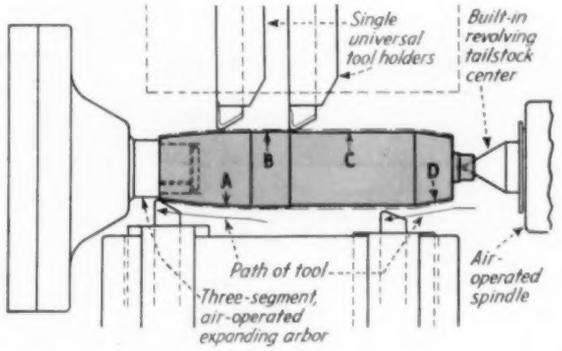


Fig. 62—A 20-hp. motor is used to drive the No. 3A × 27 in. Duomatic lathe when using the above tooling for finish turning a 75-mm. forged steel shell body

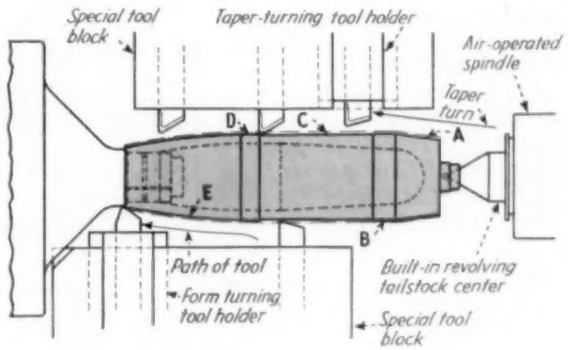


Fig. 63—High-speed steel or carbide-tipped tools can be used when finish turning a 90-mm. high explosive shell with this set-up on a No. 3A × 27 in. Duomatic lathe. A 30-hp. motor is used

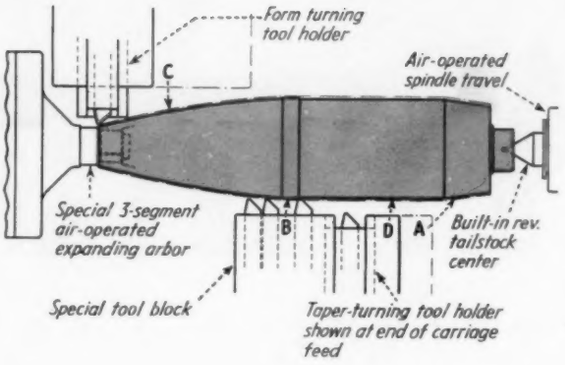


Fig. 64—Only the ogive is turned by the rear carriage tool during the finish turning of 155-mm. shell with this set-up on a No. 3A × 39 in. Duomatic lathe. Both the expanding arbor and the tailstock spindle are air operated

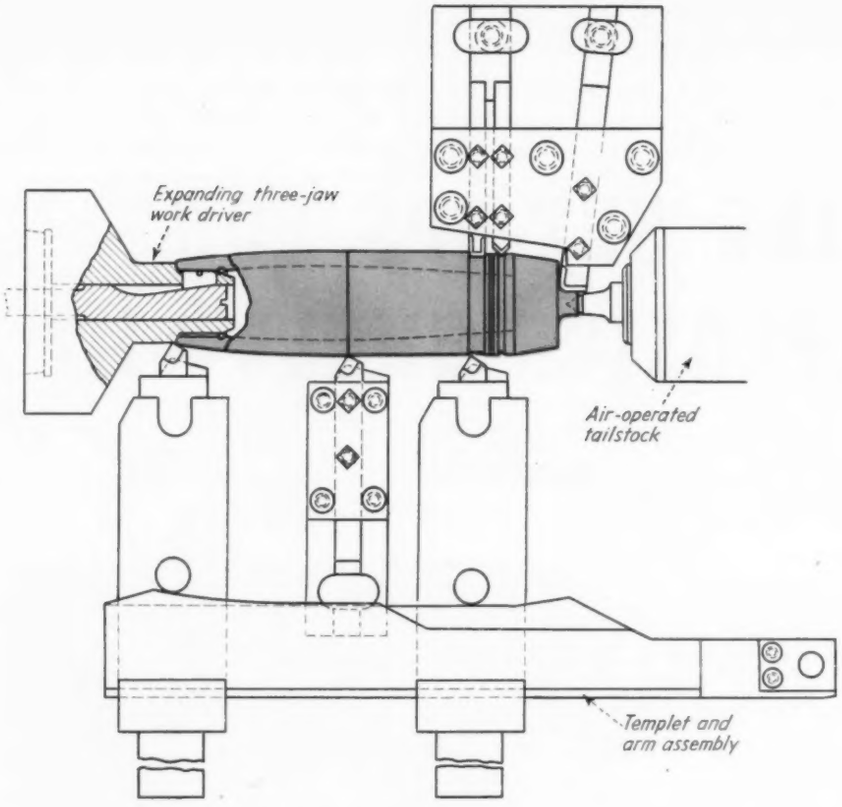


Fig. 65—This set-up for 75-mm. shell on a Model U automatic Lo-swing lathe will finish turn, form and face 40 to 60 shell per hour when using carbide-tipped tools

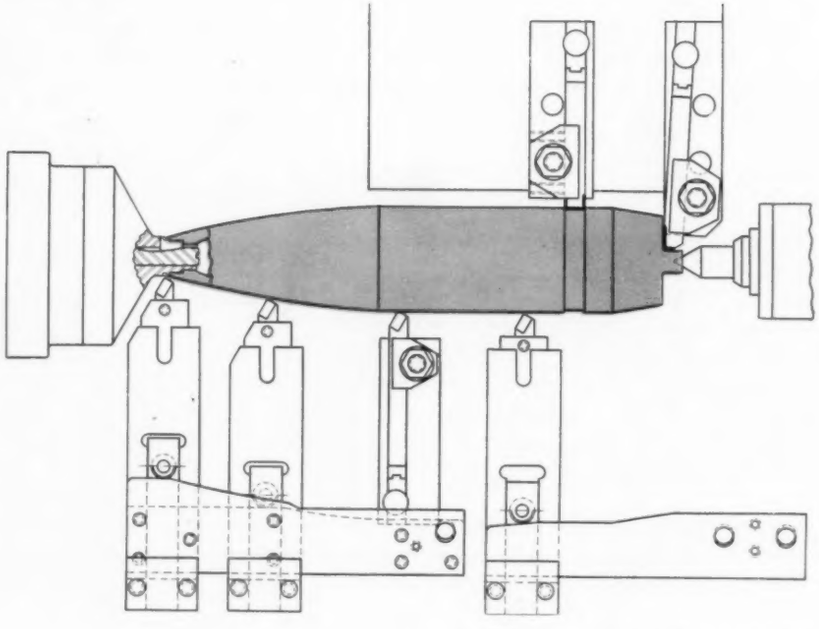


Fig. 66 — Despite the small-diameter, short-length bore available for driving this 105-mm. shell while finish turning, it was possible to maintain a cutting speed of 280 ft. per min. with 0.012 in. per rev. feed in a Model R-14 Lo-swing lathe

form-turned with the forward tool on the front carriage, while surface *B* is straight-turned with a fixed tool. At the same time, the tools on the rear carriage are taper-turning the boat-tail *A*, straight-turning surface *C*, and straight-turning the bourrelet *D*. As in the set-up for 75-mm. shell, the carriages in this set-up are arranged to power traverse forward into the cut, feed the tools at a predetermined rate to the ends of their cuts, then relieve the tools and power rapid traverse back to the starting position automatically. An almost identical tooling set-up is used on the No. 3A×27-in. Duomatic for finish-turning the 105-mm. high explosive shell.

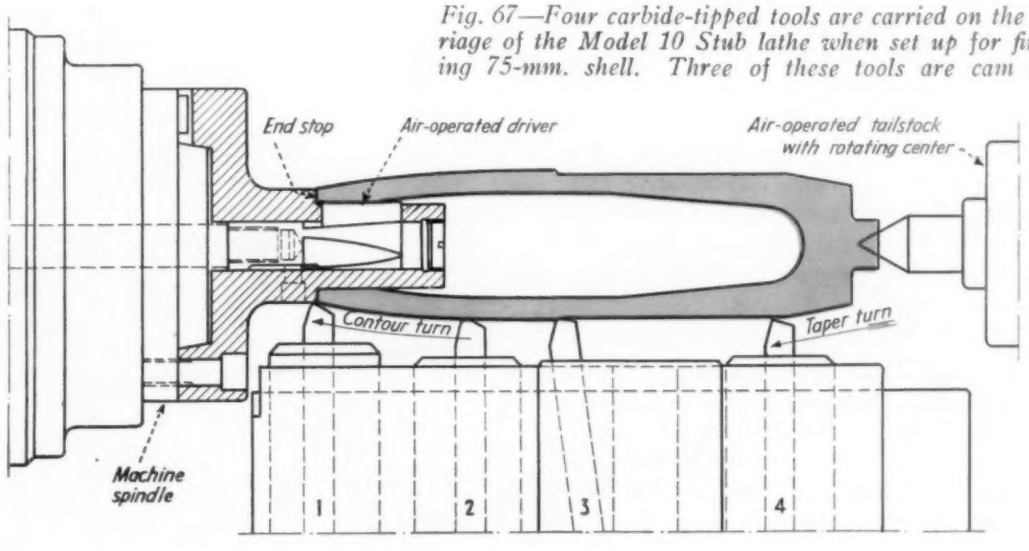
When finish-turning the M-101 or M-102 type 155-mm. high explosive shell, the tooling set-up shown in Fig. 64 has been found satisfactory for use on the No. 3A×39-in. Duomatic lathe. Here, the front carriage is provided with a taper-turning toolholder for finish-turning the boat-tail surface *A*. Also carried on the front block is a fixed tool for straight-turning surface *D*, as well as two fixed tools for semi-finish and finish turning the bourrelet *B*. Only one tool is carried on the rear carriage. This tool form-turns the entire ogive *C* while the tools in the front carriage are completing their cuts.

The tool layout shown in Fig. 65 is for the finish-turning operation on the 75-mm. shell, for which the roughing operation was shown in Fig. 38. This set-up is for a Model U automatic Lo-swing lathe, and the same method of drive is used as for the roughing operation, except that the spacing bar is not needed. Here, the shell butts against a prepared shoulder on the drive. Three tools are used for turning the ogive, straight body and boat-tail, the total length of carriage travel being 5¼ in. The closed end of the shell, as well as the band groove and cartridge crimping groove, is machined from the rear simultaneously with the turning operation. With carbide-tipped tools a production of 40 to 60 shells per hour can be maintained, depending on the quality of finish required.

In Fig. 66 is shown a set-up for finish-turning a 105-mm. shell on a Model R-14 Lo-swing automatic lathe. Here, again, the drive is with a three-jaw air-operated arbor, and it is of interest to note that despite the short, small diameter bore in which the driver fits, this shell has been machined with carbide-tipped tools at 280 ft. per min. with 0.012-in. feed. Two tools are used on the ogive, and the matching of the ogive cuts is excellent, because the two-step templet permits blending of the matching cut over a length of ¾ in. or more. The second tool from the left blends the two cuts, and is dropped back on a slightly larger radius just as soon as it contacts the surface which has been machined by the first tool.

The Sundstrand Movel 10 automatic Stub lathe with a tooling layout like that shown in Fig. 67 will finish-turn more than sixty-four 75-mm. shell per hour when using carbide-tipped tools at a cutting speed of 360 ft. per min., and a feed of 0.020 in. per rev. In this set-up the part is held and driven by an air-operated expanding jaw driver which registers in the machined nose end. Endwise location is taken from the open end of the shell, which has been faced in relation to the bottom of the cavity. The base end of the forging is supported by a rotating center in the air-operated tailstock. On the longitudinal-feeding front carriage is mounted a special toolblock which has one straight turning tool and three cam-bar controlled tools. The right-hand tool finish-turns the taper at the boat-tail, the second tool

Fig. 67—Four carbide-tipped tools are carried on the front carriage of the Model 10 Stub lathe when set up for finish turning 75-mm. shell. Three of these tools are cam controlled



from the right turns the straight diameter of the body, and the third tool finish-turns the bourrelet diameter. The left-hand tool finish-turns the ogive at the nose end of the shell. Tool relief automatically is provided for all four of these tools before power rapid return at the end of the cut. The machine has a complete automatic cycle after the part is loaded. This cycle includes rapid approach, feed, rapid return and stop, all interlocked with the starting and stopping of the spindle and the coolant flow.

The tooling set-up shown in Fig. 68 has been developed by W. C. Lipe, Inc. for use on a 15×30-in. Carbo-Matic lathe when finish-turning 75-mm. shell. This set-up also is used for 90-mm. shell with necessary changes in shape of form bar and setting of tools. The open end of the shell is held by an expanding arbor, registering endwise against the finished face of the nose end. The tantalum-carbide tool mounted on the front carriage turns the bourrelet and ogive, while a similar tool in the rear carriage turns the boat-tail and body simultaneously. Each carriage is controlled by a separate cam bar. The operator loads the work in the machine, moves one control level, automatically starting the spindle; tools rapidly approach work, plunge cut to depth, go into fine feed for the length of the bourrelet, then automatically change to a coarse feed for the balance of the cut, go into tool relief, rapidly return to loading position, and the entire machine then stops, ready for unloading. By using two feed rates it is possible to produce a very satisfactory finish on the bourrelet without adding excessive cutting time to the operation. A 20-hp. motor is used to drive the lathe. Cutting speed is approximately 375 ft. per min.

Setscrew Hole Tapped in Simple Jig

Specifications for the 75-, 90- and 155-mm. shell shown in Figs. 1 and 2 call for the drilling and tapping of a lockscrew hole 0.66 in. back of the nose end of the shell, perpendicular to the longitudinal axis of the shell. No such hole is necessary in the 155-mm. high explosive shell. Ordinarily, this operation is performed in a two-spindle sensitive drill press, with the shell located from the finish-faced nose end as in Fig. 69, or from the bottom of the cavity as in Fig. 70. Drilling for the 0.3125-18NC-2 hole is through a fixed bushing. Then the fixture is indexed to the other end of the base plate against a pair of stops which brings the hole directly beneath the tapping spindle. Ordnance Department drawings specify the following diameters for this tapped hole: major diameter, 0.3125 in. minimum; pitch diameter, 0.2764+0.0041 in.; motor diameter, 0.2524+0.0106 in.

This operation can be fitted into the machining line-up wherever desirable prior to the nose threading operation. If nose threading is done in the same set-up with other nose machining operations, following the finish turning operation, this drill and tap operation for the lockscrew should be done immediately after finish turning. However, if the threading of the fuze seat is done separately, this lockscrew hole can be drilled and tapped later.

Nose End Machined Several Ways

For high-quantity shell production, operations involved in the machining of the nose and shell forgings call for the use of a multi-spindle automatic machine. Such units reportedly have been applied very successfully in England and on the Continent, as well as in Canada and the United States. Where production requirements are not high, the following set-ups are satisfactory where the nose end is to be machined prior to finish turning of the outside sur-

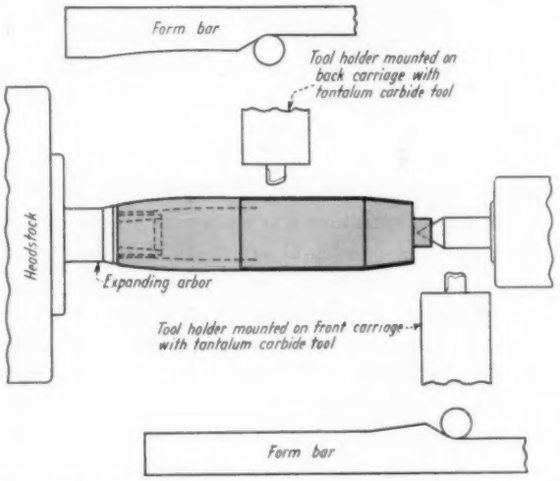

Form bar
Tool holder mounted on back carriage with tantalum carbide tool
Headstock
Expanding arbor
Tool holder mounted on front carriage with tantalum carbide tool
Form bar

Fig. 68—Suitable for 75-mm. and 90-mm. shell, this set-up for the 15 × 30 in. Carbo-Matic lathe employs two feed rates during the cutting cycle

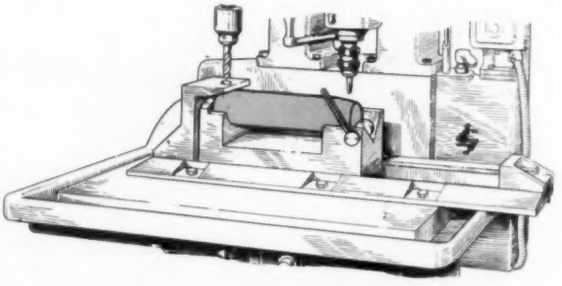


Fig. 69—A simple jig on a two spindle sensitive drill press is all that is necessary for drilling and tapping the lockscrew hole near the nose end of 75-, 90- and 105-mm. high explosive shell. Location is from the faced end of the nose

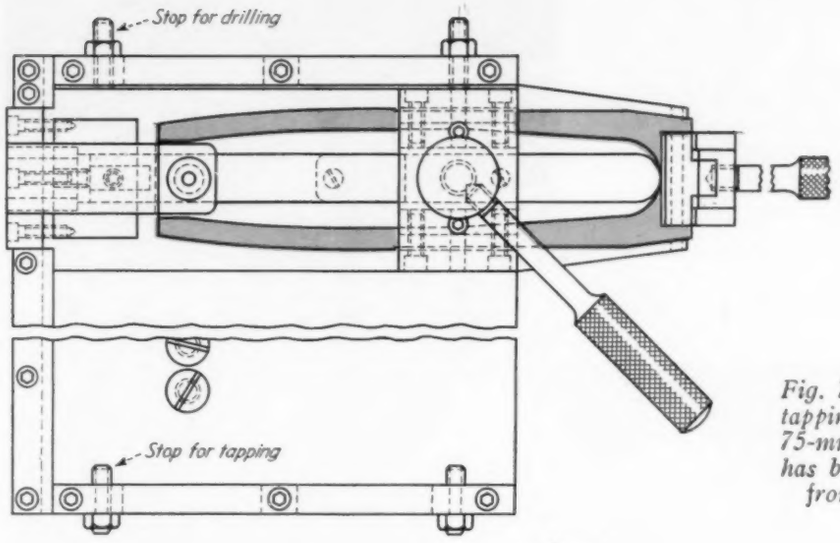
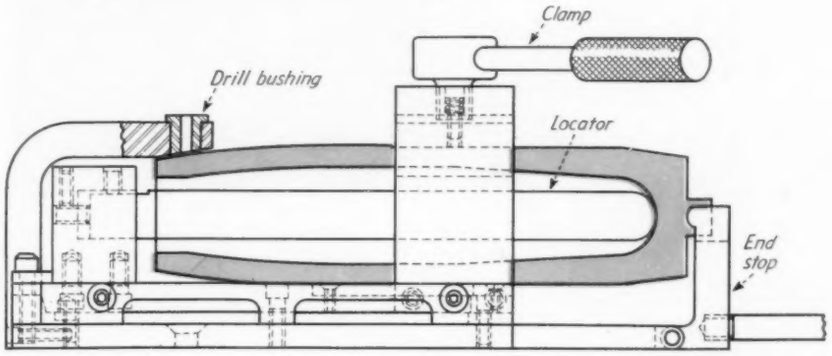


Fig. 70—Designed for drilling and tapping the lockscrew hole in 75-mm. shell before the nose end has been machined, this jig locates from the bottom of the cavity



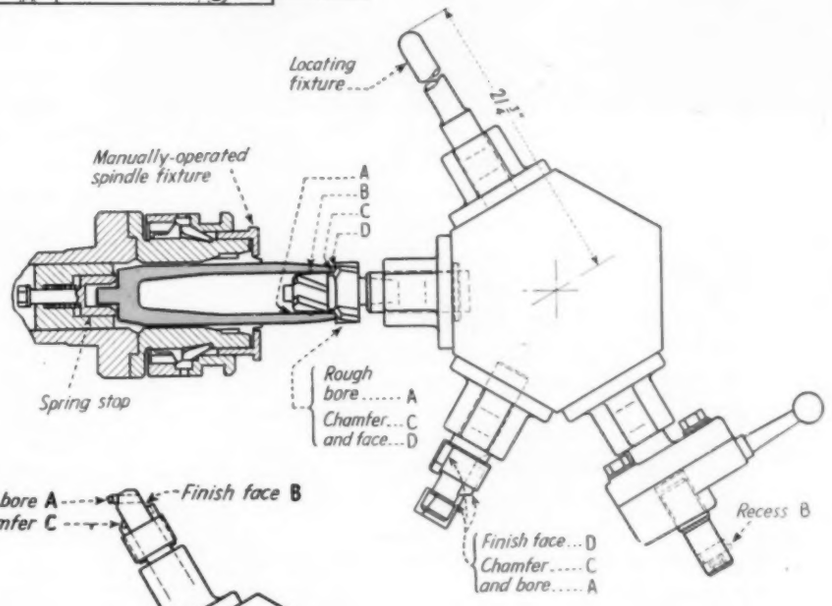


Fig. 71—Multiple blade cutters held on the hexagon turret of a J. & L. No. 5 ram type turret lathe have been used for nose-end operations on 75-mm. shell

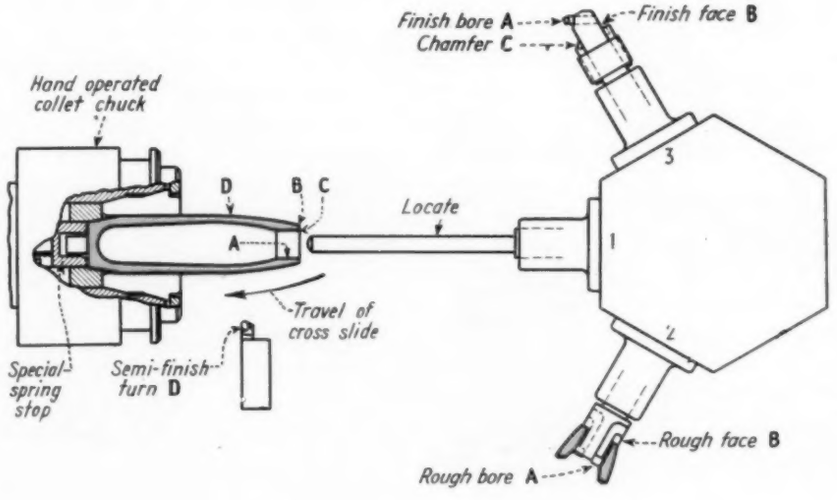


Fig. 72—Semi-finish turning of the ogive is done at the same time that the nose is bored and faced in this set-up on a J. & L. No. 7A5 turret lathe for 90- and 105-mm. shell . . . .

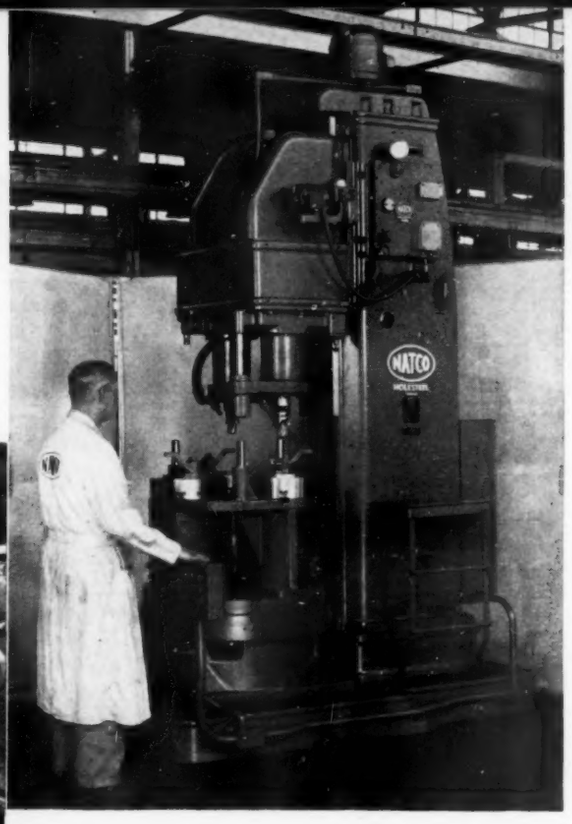
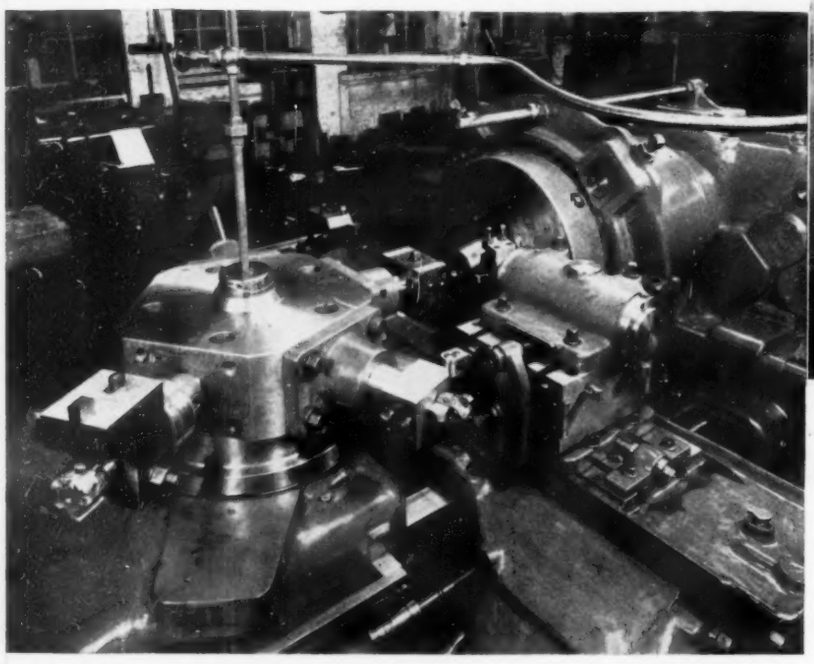


Fig. 74—Made with a three-station fixture to machine the nose end of 75- and 90-mm. shell, this Natco machine is arranged with semi-automatic hydraulic feed

Fig. 73—These tools are used in a Potter & Johnston chucking machine for machining the nose end of a 5-in. anti-aircraft shell. Forging has been rough turned and nosed-in prior to this operation



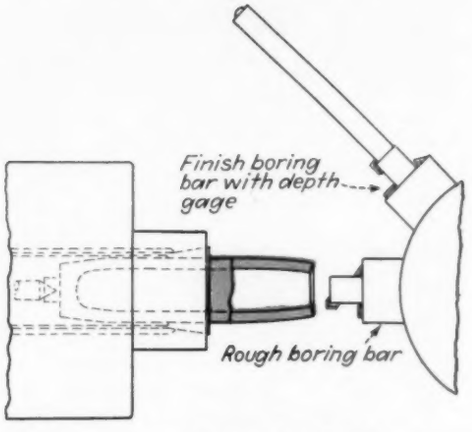


Fig. 76—A roughing and a finishing bar, each fitted with three tool bits, are used in the Blood shell lathe for nose-end operations. The finishing bar bottoms in the cavity to locate the facing tool

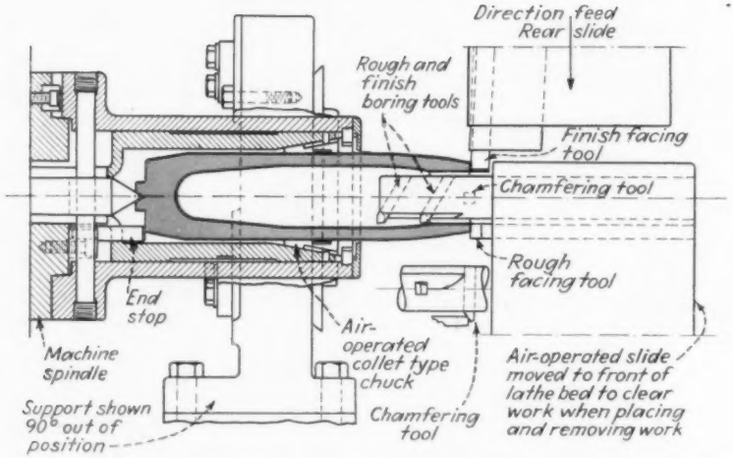

Direction feed Rear slide
Rough and finish boring tools
Finish facing tool
Chamfering tool
Rough facing tool
End stop
Machine spindle
Air-operated collet type chuck
Air-operated slide moved to front of lathe bed to clear work when placing and removing work
Support shown 90° out of position
Chamfering tool

Fig. 75—Carbide-tipped tools are used for rough and finish boring, and chamfering the nose end of 75-mm. shell in this set-up for a Sundstrand Model 8 automatic lathe

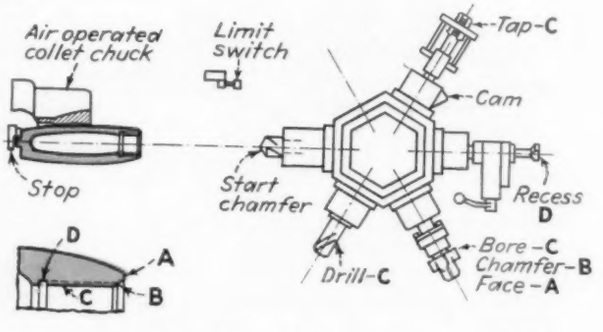


Fig. 77—This set-up for nose operations on 75-mm. shell is arranged to change motor speed automatically on the No. 5 Warner & Swasey turret lathe when starting and completing the tapping cycle

faces. The division in operation sequence which calls for machining the nose before or after the finish turning operation depends to a large extent upon the method of driving the shell when finish turning.

In the tooling layout shown in Fig. 71 developed by Jones & Lamson for machining the nose end of 75-mm. shell bodies, no tap is used because this end is to be used for driving the shell while finish turning. The No. 5 ram-type turret lathe employed is equipped with a 3-in. hand-operated collet chuck. A gage rod held in the hexagon turret locates the shell in the chuck in relation to the bottom of the cavity. Two positions of the hexagon turret have multiple-blade cutters for rough and finish boring the nose, and facing the end of the shell. A recessing tool is held in the fourth position of the turret for forming the groove at the end of the thread.

Using high-speed steel tools, the spindle is run at 119 r.p.m. for the rough boring cut, and then stepped up to 160 r.p.m. for finishing boring. This gives a surface speed of 65 ft. per min, for roughing and 90 ft. per min. for finishing. Feed is 0.047 in. per rev. for both rough and finish boring cuts, and a light hand feed is used for the recessing cut. A 10-hp. motor drives the machine. Production obtainable with this set-up is approximately 38 shell per hour.

For 90- and 105-mm. shell, Jones & Lamson has found it desirable to semi-finish turn the ogive while rough and finish boring and facing the nose end, using a set-up as shown in Fig. 72 on a No. 7A5 universal saddle-type turret lathe. Except for size, the set-ups for the 90-mm. and the 105-mm. shell are identical. This set-up differs from that used for the 75-mm. shell in that carbide-tipped tools are used. For 90- and 105-mm. sizes of shell, the spindle is rotated at 243 r.p.m. by a 10-hp. motor, thus the turning speed on the nose is 230 ft. per min. for the 90-mm. shell and 260 ft. per min. for the 105-mm. size. In each case, a feed of 0.011 in. per rev. is used for roughing operations in the nose, 0.007 in. per rev. for finishing operations in the nose, and 0.022 in. per rev. for the turning operation. Estimated production is 29 pieces per hour for the 90-mm. size and 25 pieces per hour for the larger shell.

Potter & Johnston automatic chucking machines also are well suited for operations on the nose and base ends of steel shell forgings. In Fig. 73 is shown the tooling for finishing the nose end of a 5-in. anti-aircraft shell on a Model 6-DREL P. & J. turret lathe. A positioning bar is fitted to the first turret face for locating the shell in the chuck from the bottom of the cavity. Tools on the second turret face rough bore the thread diameter and rough face the end of the forging. Meanwhile the rear slide is used to rough turn the nose with single-point tools. Finish boring of the thread diameter, semi-finish facing of the end of the forging and chamfering of the hole is done with tools on the third turret face, while tools on the fourth turret face are used for reaming the hole and finish facing the end.

For holding the shell during this operation, an air-operated pot chuck with two sets of three jaws is mounted on the end of the spindle. A block on the front cross slide and one on the sixth turret face facilitate loading the shell forging into the chuck. The photograph in Fig. 73 is taken from the rear of the machine to show the slide tool mounted on the rear cross slide for rough machining the ogive of the shell by the divided single-point method. Movement of the cross slide brings the tools into cutting position, and the turret slide action is then used to feed the slide parallel to the spindle axis. A concealed former causes the tools carried in the bar to follow the form of the ogive.

A variety of operations can be performed on the nose and base ends of shell with vertical-spindle machines when properly tooled. In Fig. 74 is shown a "Holesteel" vertical machine made by the National Automatic Tool Company for nose-end operations on 75- and 90-mm. shell. This machine has semi-automatic hydraulic feed with an automatic time delay reverse mechanism and positive stop. The head is of fixed-center design and is provided with two heavy-duty, anti-friction bearing mounted spindles with nose adjustment. For the machine shown, a 36-in. diameter, three-position hand indexed rotating table is mounted on the low base. Mounted on the table is a three-position fixture arranged to hold a 75- or 90-mm. shell in each position. Shells are located by chucking on the rough turned outside diameter, cupping on the closed end, and are jacked up against a stop which later is swung out of the way of the tools.

One of the stations in the rotating fixture is open for removing and loading shell while tools are working on shell in the two other positions. High-speed steel tools are used at the second position to rough bore the thread diameter and face the open end of the shell. Spindle is rotated at 105 r.p.m. giving a cutting speed of 49 ft. per min. for boring, and 68 ft. per min. for facing. During the boring part of the cycle feed is at 0.031 in. per rev., then when the facing tool reaches the work feed is reduced to 0.0095 in. per rev. At the third position high-speed steel tools are used for semi-finish boring the thread diameter and finish facing the open end. Speeds and feeds for this operation are the same as for the roughing tools. Total cycle time is 58 sec., and about 62 shell per hour can be machined.

For larger shell, a similar three-position fixture is

mounted on the base of a machine like that shown in Fig. 74. This fixture is arranged to hold either the 105- or the 155-mm. shell in the same manner as the smaller shell are held in the fixture on the first machine. Another similar fixture was furnished with this larger machine to hold 5-in. anti-aircraft shell as well as 105- and 155-mm. shell. Operations performed by the two spindles, as well as speeds and feeds are the same as those used for the smaller shell.

A Sundstrand Model 8 automatic lathe with tooling as shown in Fig. 75 can be used for operations on the nose end of the shell, after the shell has been rough turned and nosed-in. The lathe is equipped with a longitudinal feeding front carriage and a cross feeding rear tool slide. To the front tool slide is mounted a boring bar holder, the bar carrying a rough boring tool, a finish boring tool, a chamfering tool which breaks the corner on the inside diameters, and a rough facing tool for the nose end. A single tool carried on the cross feeding rear tool slide finish faces the open end of the shell. The piece is held in an air-operated collet-type chuck with approximately two-thirds of the shell extending back into the chuck. The closed end of the shell is supported in a spring-loaded headstock center, being positioned endwise by means of a stop inside the chuck which registers against the previously rough faced base of the shell. A roller-type steadyrest supports the outer end of the chuck. To facilitate loading and unloading of the shell in the chuck, the boring bar holder is mounted on an air-operated slide which moves back away from the work when not in use.

Controls are arranged so that they must be operated in the proper sequence. Unless the shell is clamped properly the air-operated boring slide cannot be moved into position; likewise, until the boring slide is in the proper position, the control for starting rotation of the machine spindle and carriage cycle will not operate. The cycle of the tool slides is automatic after the operator engages the starting button, and is timed and interlocked with the starting and stopping of the machine spindle and the coolant pump. Using carbide-tipped tools at 300 ft. per min. cutting speed and a feed of 0.015 in. per rev., estimated production at 85 per cent efficiency is 65 pieces per hour for 75-mm. shell.

Tooling recommended by W. C. Lipe for the Blood shell turret lathe shown in Fig. 76 is designed for rough and finish boring, facing, and chamfering the open end of 75-mm. shell. The same arrangement is used for 90-mm. shell. In this set-up, the work is held in an air-operated collet, registering endwise against machined face of the closed end, and supported at the closed end by a spring loaded center. This assures holding the finished bore concentric and parallel with the cavity. The turret has a guide bar to assure alignment of the roughing and finishing bars. Each bar carriers three tools; one for boring, one for facing and one for chamfering. The finish boring bar has a depth gage which controls the distance between the bottom of the cavity and the finish faced nose of the shell. A 7½-hp. motor is used to drive the spindle at 312 r.p.m. Either high-speed steel or carbide-tipped tools may be used.

Warner & Swasey turret lathe set-ups for nose-end operations are planned to precede the finish turning operation, even though each set-up includes tapping. In Fig. 77 is shown the layout for boring, recessing, facing and tapping the nose end of the 75-mm. high explosive shell forging. A No. 5 turret lathe with 20-in. swing and 2½×13 in. bar capacity is recommended. The air-operated collet chuck used to hold the shell is designed so that it stops and locates the shell longitudinally, establishing the length of the shell without setting any stops for the turret. This chuck is operated by a 10-in. double-acting air cylinder. A leading-on attachment is used to feed the turret while tapping.

With the set-up shown in Fig. 77 for 75-mm. shell, the first chamfering operation is done at 125 r.p.m. with hand feed. The same speed is used for drilling, boring and recessing operations, a feed of 0.030 in. per rev. being used for drilling, and 0.020 in. per rev. feed for boring. Recessing is done with hand feed. Spindle speed automatically is reduced to 62 r.p.m. for tapping, a limit switch being used to control the two-speed drive motor which runs the machine at standard and double standard speeds. After the boring operations have been completed and the tap is indexed into the tapping position, the cam on the hexagon turret operates the limit switch to automatically change the motor connections so that the spindle speed will be reduced without attention from the operator. When the tap is withdrawn and the turret returned to position, the motor is reconnected for high spindle speed.

Like the tooling for nose end operations on 75-mm. shell, the set-up shown in Fig. 78 for 90-mm. high explosive shell has been laid out for high-speed steel tools. This Warner & Swasey arrangement is designed for use on a No. 1-A hollow hexagon turret lathe with 16¼ in. swing over the side carriage and 2½×35 in. bar capacity. The collet chuck is actuated by a stationary-type air cylinder mounted on the front of the machine. The machine is cammed so that the spindle will run at standard speed for drilling and boring, and at reduced speed for tapping. Two taps are included in this set-up. It is believed that a longer life can be obtained if two tapping passes are taken. In case it is determined

that a roughing tap is not necessary, two finishing taps may be mounted on the machine, so that when one tap is down for regrinding the other may be used, without delay for resetting the tap on the machine. The nose end operations on the 90-mm. shell have been set up for chamfering, drilling and boring at 109 r.p.m., then tapping at 54 r.p.m. Chamfering is done with hand feed while a feed of 0.027 per rev. is used for drilling and boring.

Like the 75-mm. shell, the 105-mm. high explosive shell requires a recessing tool for the nose end operations, and the layout in Fig. 79 shows a recessing tool head mounted between the boring tool and the roughing tap on the hexagon turret on a No. 2-A hollow hexagon turret lathe. Like other Warner & Swasey turret lathe set-ups for nose end operations on shell bodies, this layout includes a limit switch for reducing motor speed while tapping. Likewise, a leading-on attachment is used to guide the taps. Should the user desire to tap or mill the threads in a separate set-up, the two-speed motor would be replaced by a standard single-speed motor of the same capacity. Chucking equipment for the 105-mm. shell set-up is similar to that recommended for the 90-mm. shell, being a parallel-closing type collet chuck operated by a stationary air cylinder mounted at the front of the machine. When using this chuck on the No. 2-A machine, it is necessary to bore a portion of the spindle to admit the longitudinal stop and part of the shell. This job could be put on a smaller machine, but that would mean using a special collet chuck with a steadyrest, keeping all of the shell outside of the spindle. With the set-up for 105-mm. shell shown in Fig. 79, boring, chamfering, core drilling and recessing are performed at 110 r.p.m. spindle speed, with hand feed for the rough chamfering and recessing, and with a power feed of 0.027 in. per rev. for drilling and boring. Rough and finish tapping are both done at a spindle speed of 55 r.p.m.

For the 155-mm. high explosive shell, the tooling set-up recommended by Warner & Swasey for the nose end operations is essentially the same as that for the 90-mm. shell shown in Fig. 78, except that a No. 3-A hollow hexagon turret lathe is used. The drilling, boring, and chamfering operations are performed at 93 r.p.m. and tapping is done at 47 r.p.m.

The reason for quoting a No. 3-A machine with 6-in. bar capacity for the 155-mm. shell is to provide for inserting the shell into the spindle bore, with the collet chuck operated by a stationary air cylinder at the front of the machine. With this size of machine, the shell can be chucked in such a manner that the overhang of the entire shell is cut down to a point where no steadyrest is required for supporting the chuck or the shell. On some jobs No. 1-A and No. 2-A machines have been quoted for the nose end operations on 155-mm. shell, as the machining operations are not heavy. However, the use of the smaller machines made a steadyrest necessary for supporting the chuck, and the use of this rest presented lubrication problems and difficulties in keeping three separate bearings in line. A 20-hp. two-speed motor should be used for this set-up. Production estimates for the above set-ups on Warner & Swasey turret lathes for nose end operations on shell, based on a 22½ hr. day and a 50 min. hour, show rates of 427 shell of the 75-mm. size, 293 of the 90-mm. size, 248 of the 105-mm. size and 205 of the 155-mm. size per day.

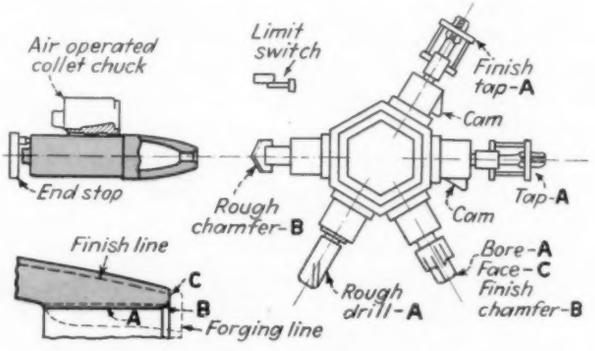


Fig. 78—Two taps are included in this set-up on a No. 1-A Warner & Swasey turret lathe for the 90-mm. shell nose-end operations. The same set-up on a 3-A turret lathe is suitable for 155-mm. shell

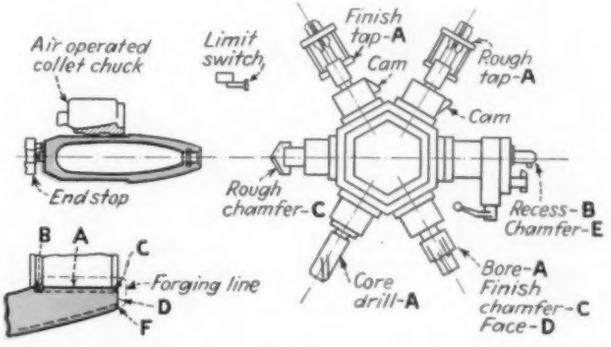


Fig. 79—A No. 2-A Warner & Swasey turret lathe is used for nose-end operations on the 105-mm. shell. Hand feed is used for rough chamfering and recessing operations with this set-up

Set-Ups After Finish Turning

The machining of the nose end of 75-, 90- and 105-mm. shell on a Gisholt No. 3 turret lathe is scheduled after the shell body has been finish turned and the base end has been machined. However, by making a slight change in the work holding chuck it

Fig. 80—The 75-, 90- or 105-mm. shell forging is finish turned and machined on the base end before delivery to this set-up on a No. 3 Gisholt ram-type turret lathe for nose-end operations

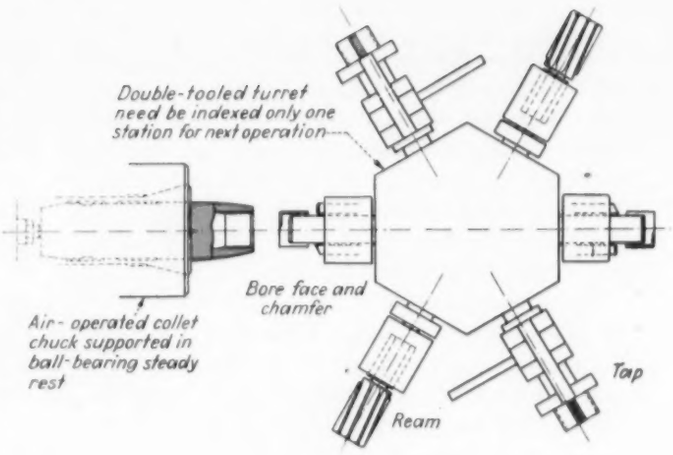

Double-tooled turret need be indexed only one station for next operation
Bore face and chamfer
Air-operated collet chuck supported in ball-bearing steady rest
Tap
Ream

Fig. 81—Nose-end operations for the 155-mm. shell on a No. 3 Gisholt turret lathe include cleaning up the cavity at the nose end by contour boring

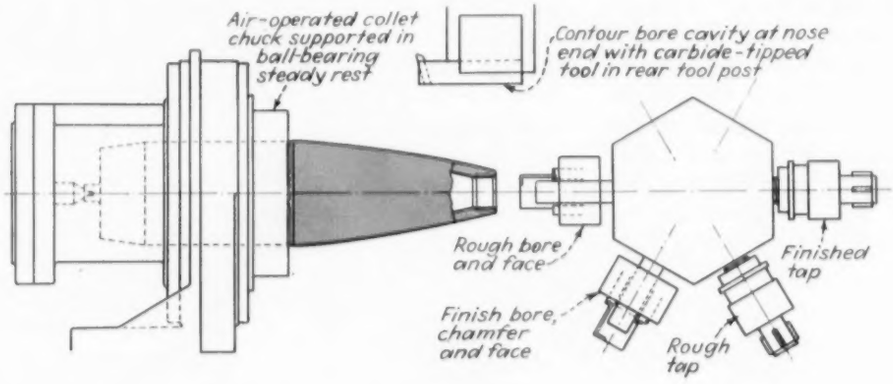
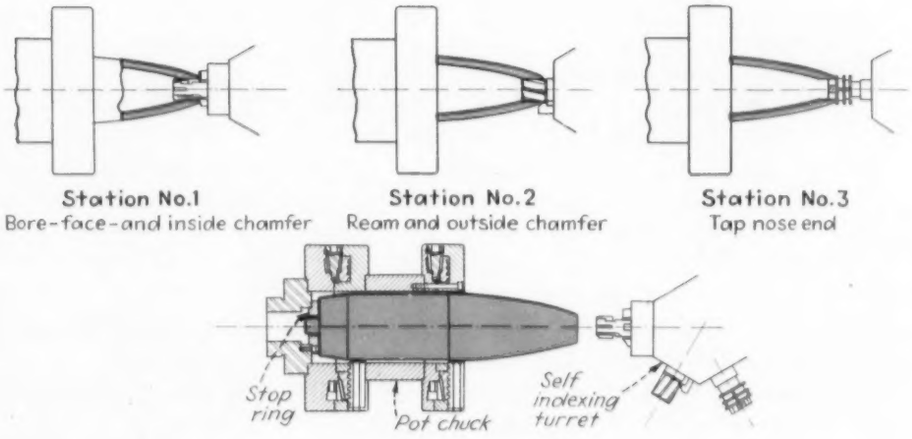

Air-operated collet chuck supported in ball-bearing steady rest
Contour bore cavity at nose end with carbide-tipped tool in rear tool post
Rough bore and face
Finished tap
Finish bore, chamfer and face
Rough tap

Fig. 82—Only three turret stations are used in the Sparks-Simplex set-up for machining the nose end of 155-mm. shell. Similar set-ups are made for smaller shell



would be possible to schedule this operation ahead of the finish turning operation. An interesting feature of the Gisholt set-up for nose end operations on these shell is the double tooling of the turret, as shown in Fig. 80. This is advantageous for two reasons. Where the tools are all in good condition, the use of a second set of tools on the turret makes it unnecessary to index the turret more than one station for any operation. At the same time, should one set of tools become dull, the machine still can be operated while that set is removed from the machine and taken to the toolroom for sharpening.

In the Gisholt set-up for nose operations on 75-, 90- and 105-mm. shell, as shown in Fig. 80, the finish turned shell is held in an air-operated collet chuck supported in a ball-bearing steadyrest. Carbide-tipped tools are used in the first turret position for boring the nose, facing the end of the shell and chamfering the bore. Spindle speed for this station is such as to give a cutting speed of 250 ft. per min. in the bore, and feed is 0.009 in. per rev. With the turret indexed to the second position, the bore is reamed at 50 ft. per min. with a high-speed steel reamer mounted in a floating holder. A collapsible tap is

mounted on the third turret position for threading the nose of the shell. A 5-hp. two-speed motor is used to drive the turret lathe for this operation. Production estimates show a floor-to-floor time of 1.3 min. for the 75-mm. shell, 1.6 min. for the 90-mm. shell, and 1.6 min. for the 105-mm. shell. In order to insure accurate threads, a threading attachment is provided for the turret in each set-up.

A Gisholt No. 3 universal ram type turret lathe with 24-in. extra bed length is set up as shown in Fig. 81 for nose-end operations on the 155-mm. forged steel shell. However, in this case the nose-end operations are performed prior to finish turning the outside surfaces. As in the set-ups for smaller shell, the turret is equipped with a threading attachment for guiding the rough and finish taps when threading the nose end of the shell. The forging is held in a special air-operated collet chuck supported in ball-bearing steadyrest, and is located longitudinally against a center in the spindle of the machine. Unlike the turret lathes used in Gisholt set-ups for smaller shell on this operation, this machine has a universal carriage carrying a rear tool post on the cross slide. Both the universal carriage and the power feed hexagon turrets have eight feeds; the turret has 20-in. effective travel. A 5-hp. motor drives the lathe.

Operation sequence for the nose end of the 155-mm. shell is as follows: Using carbide-tipped cutters and two carbide tipped facing tools, the nose first is rough bored and faced. Next, using a similar cutting head with carbide-tipped tools, the nose is finish bored, the bore is chamfered and the end is finish faced. Two collapsible taps are mounted on the turret for rough and finish tapping the fuse threads in the nose of the shell. Final operation with this set-up is the contour boring of the cavity at the nose end of the shell. Here, a carbide-tipped boring tool is supported in the rear tool post on the universal carriage, and is guided by a special cam plate and roller on the taper attachment. Using cutting speeds of about 250 ft. per min. for rough and finish boring, and 50 ft. per min. for tapping, estimated floor-to-floor time is 3.1 min. per shell, or a little more than 19 shell per hour.

Boring, facing, chamfering, reaming and tapping of the nose end of 155-mm. shell are performed at the rate of 43 shell per hour with the set-up shown in Fig. 82 for the Sparks-Simplex No. 101-A Hydro-Matic manufacturing lathe. In this set-up, the finish-turned shell is held in a special pot chuck which essentially is a combination of two three-jaw scroll chucks separated by a steel ring. Overhang from the spindle nose is considerable, and the chuck therefore is supported by a steadyrest. A self-indexing hexagon turret mounted on the cross slide has tools mounted on three stations. The sequence of operations include boring, facing and inside chamfering at station 1, reaming and outside chamfering at station 2, and tapping at station 3 with a collapsible tap. A 15-hp. motor is required to drive the lathe for this operation.

Multi-Spindle Set-Ups for End Operations

European shell producers, the Frankford Arsenal, and a number of shell contractors in Canada and the United States have found vertical and horizontal chucking machines well suited for base and nose end operations on forged steel shell bodies in sizes from 75- to 155-mm. inclusive. The shell shop at Frankford Arsenal employs chucking machines for finish machining both ends of the shell, the set-up recently described (*AM*—Vol. 48, page 667) having been for an eight-spindle double indexing unit. The 75-mm. shell delivered to this machine are finish turned.

In this New Britain-Gridley set-up on a Model 86 machine, the shell is chucked in the eighth station, locating from the base of the cavity and the outside diameter. It is indexed to station 2 where a carbide-tipped tool rough faces the base at a feed of 0.0136 in. per rev., then to station 4 where an end mill machines the lug to the rough base thickness, meanwhile a carbide-tipped form tool cuts the band-seat grooves and the cartridge case crimping groove at a feed of 0.0017 in. per rev. At station 6, the base of the shell is finish faced to the correct thickness with a feed of 0.019 in. per rev. After the shell is machined on the base end, it is removed from the chuck in the eighth station, inverted and placed in station 1 with the open end out, where it is located from the outside base end and chucked on the outside diameter. At station 3 the open end is rough bored and rough faced, then at station 5 the open end is reamed, making the shell ready for the tapping operation. In some set-ups a recessing tool replaces the reamer at station 5, to permit undercutting at the end of the nose threads. In this position the open end is chamfered with a carbide tool. At the last station on this machine, the shell mouth is finish faced to the correct distance from the bottom of the cavity and is tapped with a collapsible tap. About 600 shell are produced in an 8-hr. day. Spindle speed at each station is 144 r.p.m., giving a cutting speed of 110 ft. per min. for the forming tool.

A typical set-up for 75-mm. shell on an eight-spindle Model 86 New Britain-Gridley chucking machine fitted for double indexing is shown in Fig. 83. Shell that have been finished on both ends are shown in the collets at the two loading positions. It will be noted that work is gripped close to the

cutting tools with a minimum amount of overhang.

Nose and base end operations on 75- to 105-mm. shell also can be done successfully in Model 412 four-spindle New Britain-Gridley chucking machines, the machine being tooled in each case for machining only one end of the shell. Collet chucks used are shown in Fig. 84 and the tooling set-up for base-end operations is shown in Fig. 85. When this machine is set up for finishing the nose end of the shell, a gear-driven positive lead tapping spindle is used to insure production of accurate threads. Production for base-end operations varies from 101 per hour for the 75-mm. shell to 64 per hour for 105-mm. shell. When set up for nose-end operations the production obtainable is approximately 100 per hour for the 75-, 90- and 105-mm. shell.

For the 3-in. M42B2, anti-aircraft shell and the 75-mm. shell made from tubing the Model 86 eight-spindle New Britain-Gridley chucking machine with a double indexing attachment will give a production of about 95 pieces per hour. Spindle speed is 144 r.p.m., giving a cutting speed of 110 ft. per min. on the outside diameter. Recommended tooling for such shell is shown in Fig. 86. As in other set-ups for shell in New Britain-Gridley machines, this lay-out calls for hydraulic operation of chucks, permitting pressure to be regulated to suit the individual job. Pressure also may be varied in different positions.

Bullard Type D Mult-Au-Matic vertical multiple-spindle chucking machines easily can be adapted for nose and base operations on forged steel shell bodies. Except for special cutting tools, the only change necessary in the standard machine to adapt it for shell work is to install hollow-bored spindles with power-operated collet fixtures and locators. With these machines boring, turning, facing, threading, grooving, drilling or any combination of these operations are performed in sequence, simultaneously with the loading and unloading of the work, thereby producing a completely finished piece in the time consumed by the longest single operation, plus the short time required for indexing the carrier and its spindles from one station to the next. A different spindle speed, together with independent and variable feeds for the tools, is possible at each work station.

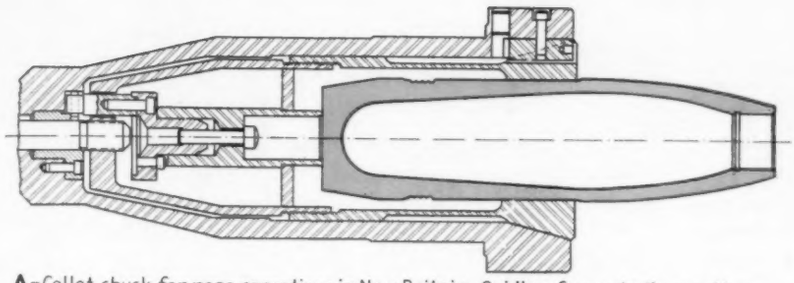
In Fig. 87 is shown a tooling layout for finish machining the base and nose ends of 75-mm., M48, high explosive shell bodies in an 8-in. eight-spindle, double indexed Mult-Au-Matic. First, the finish-turned shell body is set nose-end down in a power-operated collet fixture at station 2. Details of this fixture are shown in Fig. 88. A bar with an adjustable stop extends up into the cavity of the shell, so that the base machining operations can be held in definite relation with the bottom of the shell cavity. Also, the nose end of the shell is centered in the hollow spindle by a spring-loaded assembly carrying a hardened cone which fits around the nose of the shell. A hand-operated hold-down bar is held against the base end of the shell until the power-operated collet fixture has been closed around the shell body. This same type of fixture also is used for the 90-, 105- and 155-mm. shell, larger sizes being used on larger machines.

The first indexing of the spindle carrier takes the chucked 75-mm. shell to station 4, as shown in Fig. 87, where high-speed steel tools on a double-purpose head remove the center boss and rough-face the base of the shell. In this instance the spindle is rotated at 208 r.p.m., and the feed is 0.0091 in. per rev. The tool removing the boss feeds vertically and cuts at 54 ft. per min. The second tool block moves horizontally to rough face the base at 137 ft. per min.

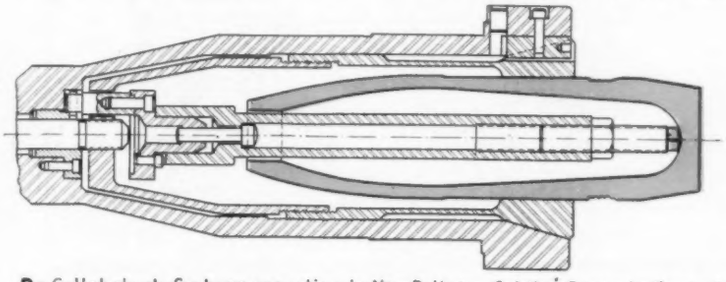
At station 6 a cam-fed compound head moves horizontally to form turn the band seat and crimping groove. Here, the spindle rotates at 100 r.p.m. to give a cutting speed of 78 ft. per min. Feed is 0.0086 in. per rev. Final operations on the base end are performed at station 8, where two high-speed steel tools are moved horizontally to finish face the base end and to chamfer one side of the band groove. For this station the spindle speed is 208 r.p.m., feed is 0.0153 in. per rev. and cutting speed is 136 ft. per min. High-speed steel tools are used.

Upon return to station 2, the shell is removed from the fixture and another shell inserted so that the cycle can be repeated. Shell removed from station 2 is upended and placed base down in another power-operated collet fixture at station 1 for the nose operations. Details of this fixture are shown in Fig. 89. From station 1, the shell is indexed to station 3 where the double purpose head carries a boring bar and a facing tool. The boring bar carries two high-speed steel bits for rough boring, and a high-speed steel chamfering tool. While the bar is fed vertically, the facing tool is fed horizontally to rough face the end of the forging. Spindle speed is 280 r.p.m., giving a cutting speed of 175 ft. per min. for the boring tools. Feed is 0.0132 in. per rev.

Next, the shell is indexed to station 5 where a plain compound head carries a boring bar and a facing tool. The entire assembly is fed vertically down to finish bore, then is fed horizontally to finish face the end of the shell and to cut the groove in the bore. Spindle speed is 300 r.p.m., and cutting speed is 186 ft. per min. Feed is 0.0146 per rev. Final operation on the nose end of the shell is performed at station 7 where a positive lead cam feeds a collapsible tap into the nose. Spindle speed for this station is 43 r.p.m., giving a cutting speed of 22 ft. per min. At 85 per cent efficiency, production estimates show a



A–Collet chuck for nose operations in New Britain–Gridley four spindle machine



B– Collet chuck for base operation in New Britain– Gridley four spindle machine

Fig. 84—These sectional views show the collet chucks and work stops employed on New Britain-Gridley machines for operations on each end of forged steel shell bodies. Design of the spindles is such that the shell overhang is kept at a minimum

Fig. 85—This view of a Model 412 four-spindle New Britain - Gridley chucking machine set-up for base-end operations on a 75-mm. shell shows the adjustable work cradle developed to facilitate loading and unloading work pieces. An hydraulic ram may be added to move shell in and out of the chucks

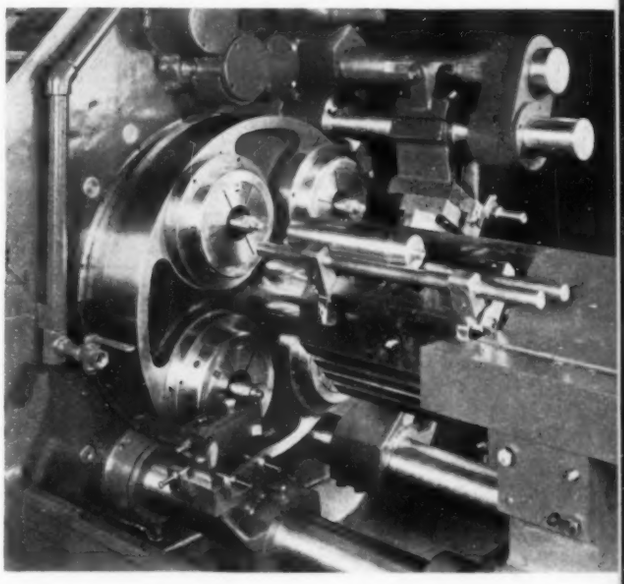


Fig. 83—The Model 86 New Britain-Gridley machine is equipped with a double indexing mechanism when set up for nose and base operations on 75-mm. shell

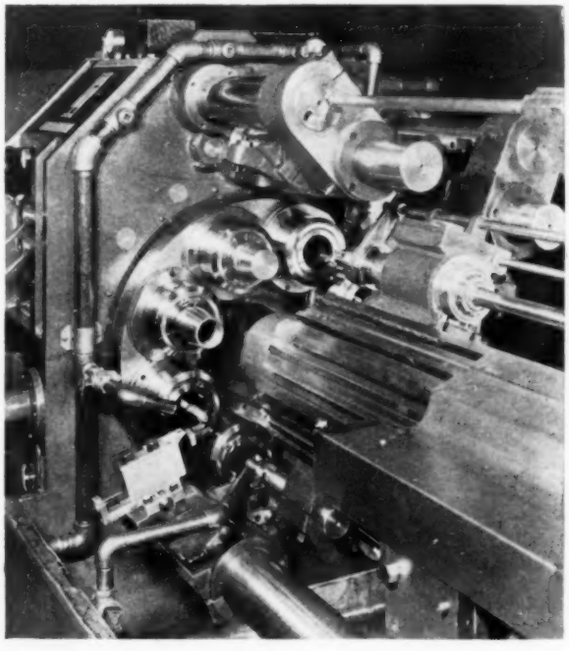
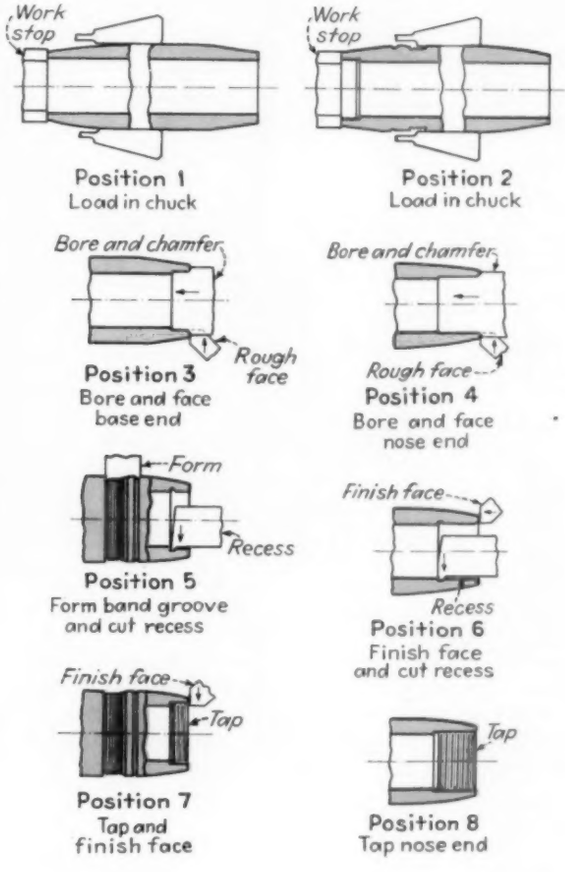


Fig. 86—When shell are made from tubing, both ends must be tapped. An eight-spindle New Britain-Gridley chucking machine is used with this tooling set-up when machining such shell



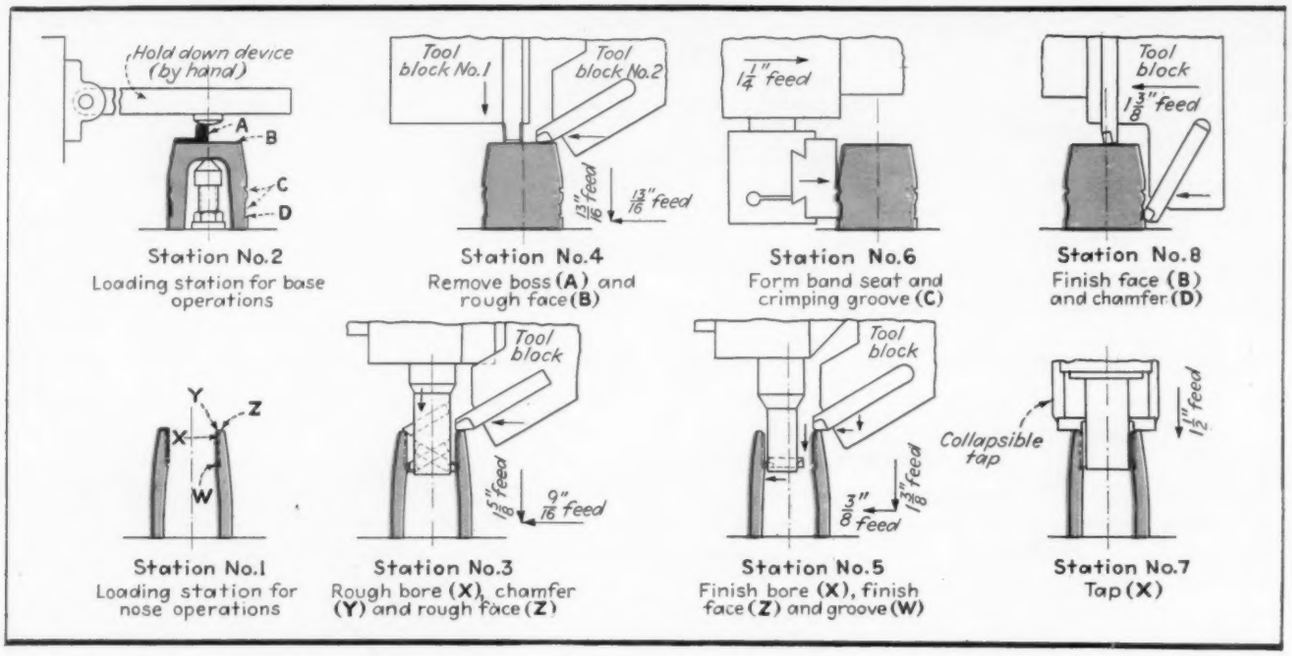


Fig. 87—Two chuckings in an 8-in. eight-spindle Bullard Mult-Au-Matic with double indexing complete the base and nose operations on 75-mm. shell. A similar set-up on a 12-in. machine finishes the two ends of 90-mm. shell

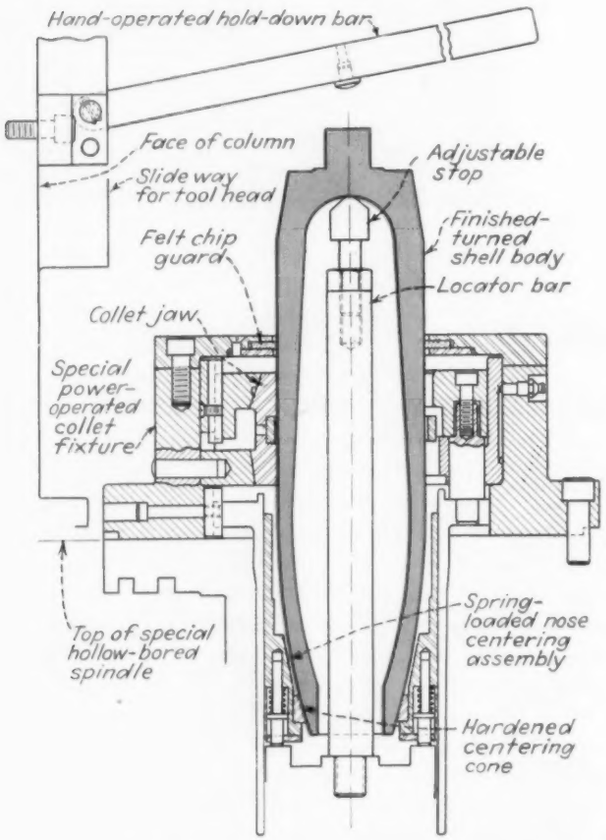


Fig. 88—Power operated collet fixtures of this type are fitted in hollow-bored spindes of otherwise standard Bullard Mult-Au-Matics for base-end operations on 75-, 90-, 105- and 155-mm. shell. Location is from bottom of cavity and finished body

Fig. 89—For second chucking operations on shell in Bullard Mult-Au-Matics, this power-operated collet fixture locates the shell from the finished base and the finish-turned body

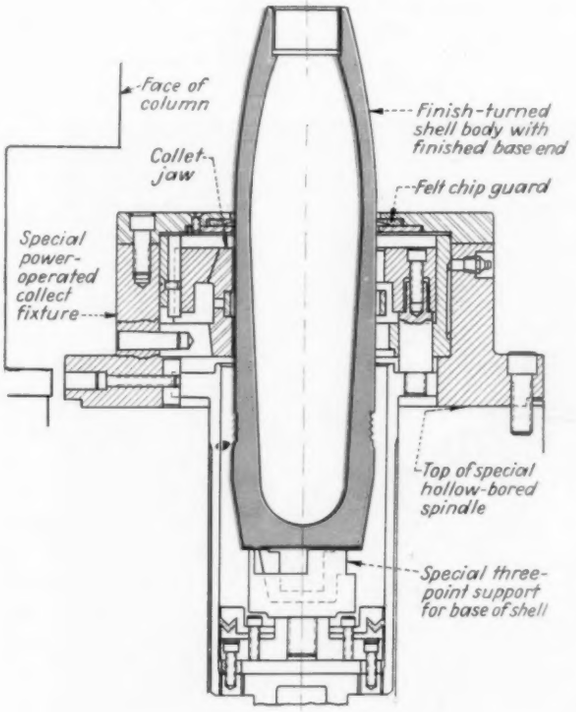

Face of column
Collet jaw
Special power-operated collect fixture
Finish-turned shell body with finished base end
Felt chip guard
Top of special hollow-bored spindle
Special three-point support for base of shell

Fig. 90—Hand-operated hoists should be used for placing and removing 105-mm. shell bodies from spindle fixtures on the 12-in. Mult-Au-Matic. One hoist should be equipped with a nose-grab for station 1, while a second hoist with a base grab is needed at Station 2. Design of the nose grab is shown in Fig. 91

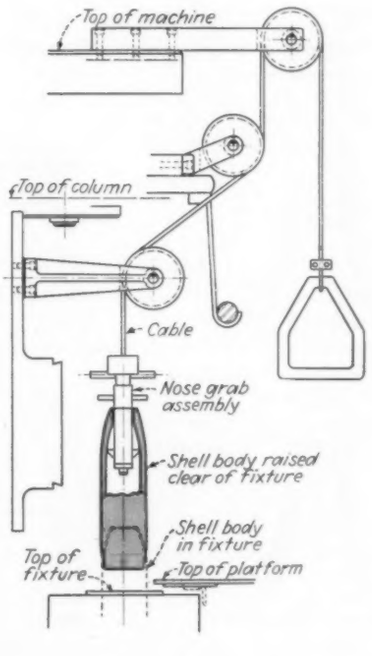
total of 73 pieces completed per hour with this set-up. As the tapping cannot be speeded up, the use of carbide-tipped tools could not be justified from the standpoint of increased production.

A 12-in. eight-spindle, double indexed Type D Mult-Au-Matic is recommended for the nose and base end operations on 90-mm. shell that have been finish turned, using a set-up like that shown in Fig. 87, except that a grooving tool is not necessary at the fifth station of the second chucking. Speeds and feeds used, and length of some of the tool movements, are slightly different than used for the 75-mm. shell, but a production of 65 pieces per hour is estimated for the 90-mm. shell at 85 per cent efficiency. Both the 75- and the 90-mm. shell are light enough to be handled easily by hand, so no lifting devices are provided, as is the case for 105-mm. and 155-mm. shell when machined on Mult-Au-Matics.

Base and nose finishing operations on the 105-mm. shell body are performed in a 12-in. eight-spindle, double-indexed Type D Mult-Au-Matic with a set-up like that shown in Fig. 87, using power-operated collet fixtures as shown in Figs. 88 and 89. Size of fixtures, tools and other details is, of course, considerably larger than those used for the 75- and 90-mm. shell. Also, a hand-operated loading and unloading device like that shown in Fig. 90 is recommended because of the weight of the shell body. One of these fixtures is located at station 1, with a grab like that shown in Fig. 91 for the nose end of the shell, and a second unit is at station 2 with a grab for the base end. Estimated production for the completed cycle, including base and nose end operations, on 105-mm. shell is 59 pieces per hour at 85 per cent efficiency. High-speed steel tools are used.

A 16-in. six-spindle Type D Bullard Mult-Au-Matic vertical chucking machine is used for base-end operations on finish turned 155-mm. shell bodies. The tooling shown in Fig. 92 easily can be modified for the several variations in 155-mm. shell. The shell body first is loaded, nose-end down, in a power-operated collet type fixture like that previously described. The shell then automatically is indexed from station 1 to station 2, where a carbide-tipped tool rough turns the band groove at 104 r.p.m., or 168 ft. per min. cutting speed. Feed is 0.0124 in. At the third station, a high-speed steel tool removes the boss at 110 r.p.m., or a cutting speed of 33 ft. per min. Feed is 0.0088 in. per rev.

A double-purpose head is used at station 4 for taper turning the boat-tail, facing the base end and chamfering. The shell is rotated at 110 r.p.m., giving a cutting speed of 175 ft. per min., and the carbide-tipped tools are fed at 0.0169 in. per rev. The tool head is fed down 3 in. and then 3 in. across, the taper turning tools being guided by a slotted former. Tooling at stations 5 and 6 was worked up for a band groove which was undercut at each side and required waved bands. The undercutting was done with high-speed steel tools. It will be noted that the two tool magazines at station 5 are fed at an angle with the horizontal for a distance of $\frac{3}{8}$ in. each way. Here, the work is rotated at 32 r.p.m. to give a cutting speed of 50 ft. per min. Feed is 0.0083 in. per rev. At station 6 a plain compound tool head equipped with a waving head and overhead drive is used for producing the waved bands. This operation is done at 25 r.p.m. (cutting speed is 38 ft. per min.)



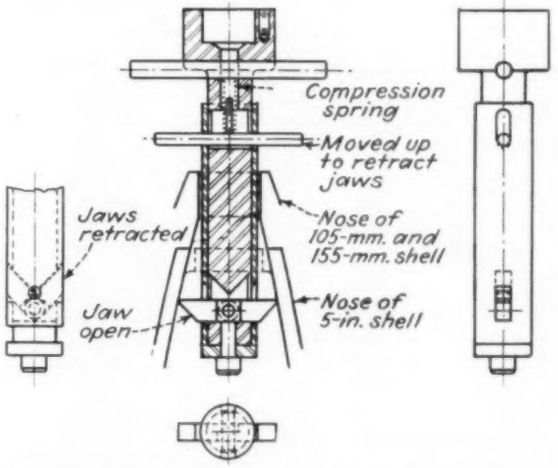


Fig. 91—Employed both on hand and power hoists for lifting shell in and out of Mult-Au-Matic fixtures, this simple hand-operated nose grab is made in one size for 105- and 155-mm. and 5-in. shell

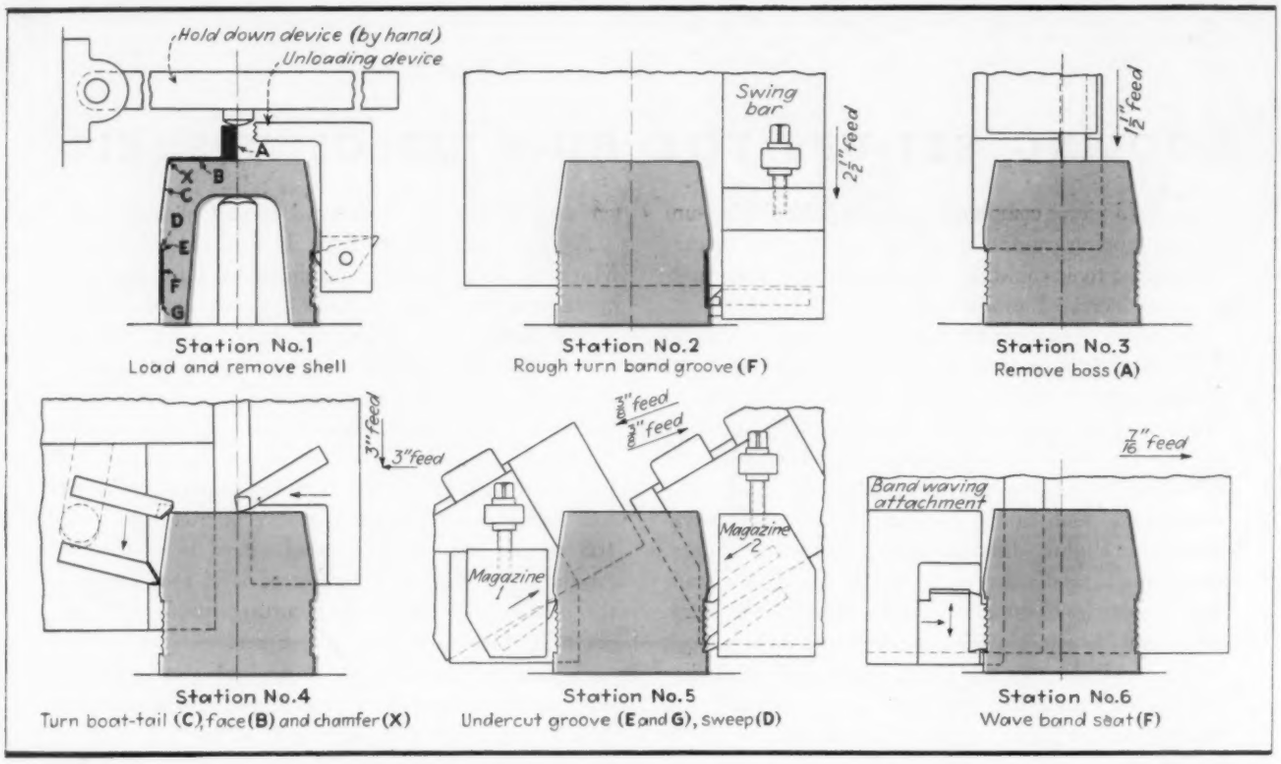


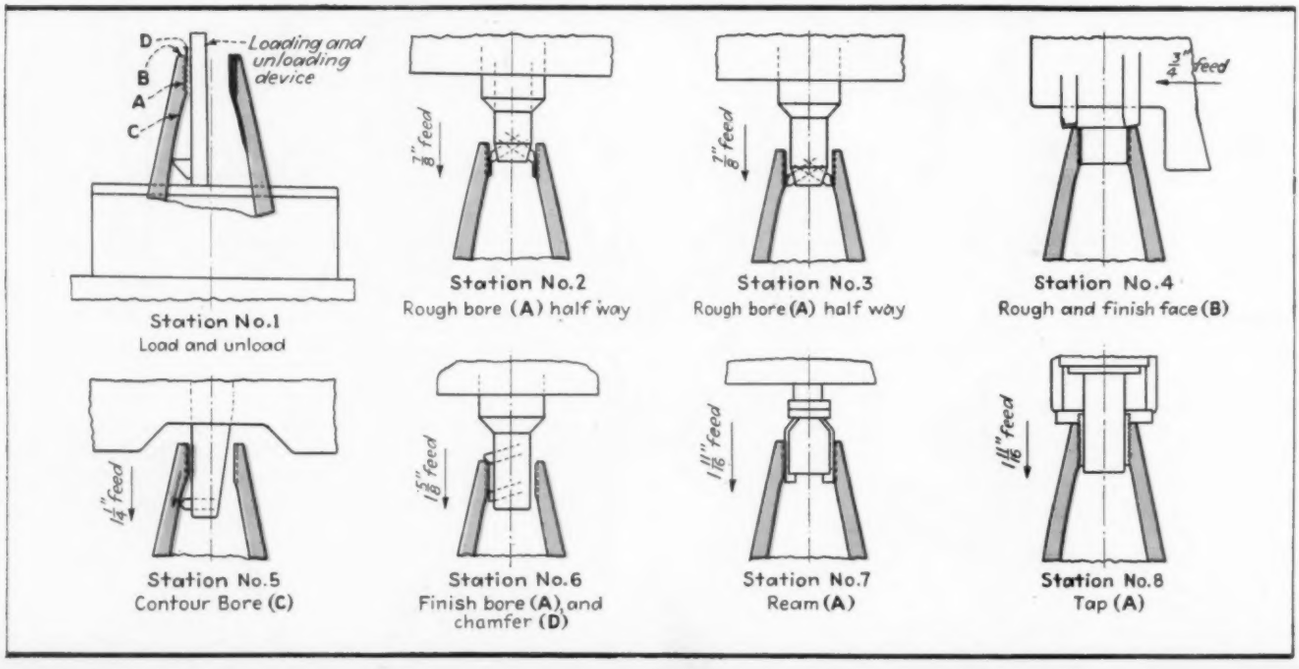
Fig. 92—A 16-in. six-spindle Type D Mult-Au-Matic is used for machining the base end of the 155-mm. shell. Differences in design of band groove for the various types of this shell call for different tooling set-ups at stations 5 and 6. Both high-speed steel and carbide-tipped tools are used

and a feed of 0.0117 in. From here, the work is indexed back to station 1 for unloading. Total cycle time is such that production is estimated at 27.5 shell per hour. Tooling at stations 5 and 6 must be modified for any changes in design of the band groove.

Following the first chucking of 155-mm. shell in a 16-in. six-spindle Mult-Au-Matic for the base-end operations, these shell are transferred to another Mult-Au-Matic for nose end operations. A number of set-ups have been developed for this second chucking. The one shown in Fig. 93 is for a 16-in. eight-spindle Type D Mult-Au-Matic. The power-operated collet fixtures used on this machine are similar in design and arrangement to that shown in Fig. 89, and the loading and unloading device used is like that shown in Fig. 91. Because of the extra weight of 155-mm. shell a power hoist assembly is recommended for Mult-Au-Matics tooled for nose and base end operations on these shells.

The fourth of this series of articles discussing various methods used for machining high-explosive shell will appear in an early number.

Fig. 93—After machining the base end of 155-mm. shell in the set-up shown in Fig. 92, they are chucked in this set-up on a 16-in. eight-spindle Mult-Au-Matic for the nose-end operations. Other tooling layouts for these operations call for 16-in. six-spindle Mult-Au-Matics



TIME-DATA SHEET NO. 35

Sensitive Drill Press Operations—XI

(*Continued from Time-Data Sheet No. 34*)

Tighten and release one long locating screw by hand:
$0.0038 = 1.02(S_3 + T_3) = 1.02(0.0021 + 0.0016)$.
Tighten and release two long locating screws by hand:
$0.0048 = 1.02(U_3 + V_3) = 1.02(0.0027 + 0.0020)$.
Tighten and release locating screw with wrench:
$0.0054 = 1.02(W_3 + X_3) = 1.02(0.0035 + 0.0018)$.
Tighten and release thumb nut by hand:
$0.0013 = 1.02(Y_3 + Z_3) = 1.02(0.0008 + 0.0005)$.
Tighten and release hexagon or square nut with open end wrench:
$0.0035 = 1.02(B_4 + C_4) = 1.02(0.0018 \times 0.0016)$.
Open and close cover of jig when hinged:
$0.0008 = 1.02(D_4 + E_4) = 1.02(0.0003 + 0.0005)$.
Put on and remove cover of jig when not hinged:
$0.0030 = 1.02(F_4 + G_4) = 1.02(0.0020 + 0.0009)$.
Put on and remove clamp from jig:
$0.0020 = 1.02(H_4 + J_4) = 1.02(0.0010 + 0.0010)$.
Drive and release drift pin:
$0.0008 = 1.02(L_4 + M_4) = 1.02(0.0005 + 0.0003)$.
Put in and remove locating pin:
$0.0047 = 1.02(N_4 + P_4) = 1.02(0.0018 + 0.0028)$.
Move very small or small part, jig or vise to spindle, or from spindle to spindle, and raise and lower spindle:
$0.0013 = 1.02(Y_2 + 2R_4) = 1.02(0.0007 + 0.0003 + 0.0003)$.
Move medium part, jig or vise to spindle, or from spindle to spindle, and raise and lower spindle:
$0.0018 = 1.02(Z_2 + 2R_4) = 1.02(0.0012 + 0.0003 + 0.0003)$.
Move large part, jig or vise to spindle, or from spindle to spindle, and raise and lower spindle:
$0.0022 = 1.02(A_2 + 2R_4) = 1.02(0.0016 + 0.0003 + 0.0003)$.
Move very small or small part, jig or vise from hole to hole, and raise and lower spindle:
$0.0011 = 1.02(B_3 + 2R_4) = 1.02(0.0005 + 0.0003 + 0.0003)$.
Move medium part, jig or vise from hole to hole, and raise and lower spindle:
$0.0014 = 1.02(C_3 + 2R_4) = 1.02(0.0008 + 0.0003 + 0.0003)$.
Move large part, jig or vise from hole to hole, and raise and lower spindle:
$0.0016 = 1.02(D_3 + 2R_4) = 1.02(0.0010 + 0.0003 + 0.0003)$.
Apply lubricant to tap:
$0.0003 = 1.02(T_4/2) = 1.02(0.0006/2) = 1.02 \times 0.0003$.

INSPECTION:

Parts must be machined as specified on the drawing or manufacturing information. Holes must be spaced properly and kept within the allowed tolerances.

WAGE PAYMENT:

Standard time wage payment on either group or individual incentive plan.

Table No. 12—Drilling Time per Inch for Various Materials

Dia. of Drill	Length of Lead	Brass	Cast Iron, Ma. Iron or Copper	C.R.S. or H.R.S.	Axle or Cast Steel	Slate	Marble	Asbestos
1/8	0.037	0.00102	0.00240	0.00540	0.00590	0.00700	0.01160	0.00438
5/64	0.042	0.00110	0.00245	0.00550	0.00600	0.00670	0.01125	0.00416
3/32	0.047	0.00118	0.00250	0.00560	0.00610	0.00650	0.01098	0.00400
7/64	0.052	0.00124	0.00255	0.00570	0.00620	0.00625	0.01060	0.00380
1/16	0.057	0.00130	0.00260	0.00580	0.00640	0.00606	0.01038	0.00363
13/64	0.061	0.00136	0.00265	0.00590	0.00650	0.00590	0.01010	0.00347
7/32	0.066	0.00140	0.00270	0.00600	0.00660	0.00568	0.00982	0.00330
15/64	0.070	0.00145	0.00275	0.00610	0.00670	0.00550	0.00950	0.00316
1/4	0.075	0.00148	0.00280	0.00620	0.00680	0.00533	0.00930	0.00300
17/64	0.080	0.00151	0.00285	0.00630	0.00690	0.00520	0.00912	0.00293
9/32	0.084	0.00155	0.00290	0.00640	0.00700	0.00510	0.00890	0.00280
19/64	0.089	0.00160	0.00295	0.00650	0.00710	0.00492	0.00874	0.00271
5/16	0.094	0.00162	0.00300	0.00660	0.00730	0.00485	0.00860	0.00265
11/32	0.103	0.00166	0.00310	0.00680	0.00750	0.00478	0.00835	0.00254
3/8	0.113	0.00170	0.00320	0.00710	0.00780	0.00478	0.00825	0.00246
13/32	0.122	0.00175	0.00330	0.00730	0.00800	0.00480	0.00825	0.00241
7/16	0.131	0.00179	0.00340	0.00750	0.00830	0.00490	0.00827	0.00239
15/32	0.141	0.00183	0.00350	0.00770	0.00850	0.00503	0.00830	0.00238
1/2	0.150	0.00187	0.00360	0.00790	0.00870	0.00517	0.00839	0.00237
17/32	0.159	0.00191	0.00365	0.00810	0.00890	0.00533	0.00860	0.00237
9/16	0.169	0.00195	0.00375	0.00830	0.00910	0.00550	0.00880	0.00237
19/32	0.178	0.00201	0.00385	0.00860	0.00940	0.00563	0.00900	0.00237
5/8	0.188	0.00204	0.00395	0.00880	0.00970	0.00580	0.00930	0.00237
21/32	0.197	0.00208	0.00405	0.00900	0.00990	.....	.....	.....
11/16	0.206	0.00212	0.00415	0.00920	0.01010	.....	.....	.....
23/32	0.216	0.00216	0.00425	0.00940	0.01030	.....	.....	.....
3/4	0.225	0.00220	0.00430	0.00960	0.01070	.....	.....	.....

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A.S.A. Std. Drill Diameter — Dec. Inch	Circumference of Drill — Inches	Area of Circle Drilled — Sq. In.	Cutting Speed (Ft. Per Min.) for Each Rev. Per Min. of Drill	Rev. Per Min. Necessary for One-Ft. Per Min. Cutting Speed of Drill
0.0156	0.04901	0.000191	0.004084	244.853
0.0180	0.05655	0.000254	0.004712	212.206
0.0200	0.06283	0.000314	0.005236	190.985
0.0225	0.07069	0.000398	0.005891	169.765
0.0240	0.07540	0.000452	0.006283	159.155
0.0260	0.08168	0.000531	0.006807	146.912
0.0280	0.08796	0.000616	0.007330	136.418
0.0295	0.09268	0.000684	0.007723	129.482
0.0312	0.09018	0.000765	0.008168	122.427
0.0330	0.10367	0.000855	0.008639	115.749
0.0350	0.10996	0.000962	0.009163	109.135
0.0370	0.11624	0.001075	0.009687	103.235
0.0390	0.12252	0.001195	0.010210	97.941
0.0410	0.12881	0.001320	0.010734	93.164
0.0430	0.13509	0.001452	0.011257	88.830
0.0453	0.14231	0.001612	0.011860	84.320
0.0469	0.14734	0.001728	0.012278	81.444
0.0492	0.15457	0.001900	0.012881	77.636
0.0512	0.16085	0.002061	0.013404	74.604
0.0531	0.16682	0.002215	0.013902	71.935
0.0550	0.17279	0.002376	0.014399	69.449
0.0571	0.17939	0.002561	0.014949	67.896
0.0591	0.18567	0.002743	0.015472	64.632
0.0610	0.19164	0.002922	0.015969	62.612
0.0625	0.19635	0.003068	0.016363	61.115
0.0630	0.19792	0.003117	0.016493	60.630
0.0650	0.02420	0.003328	0.017017	58.765
0.0670	0.21049	0.003526	0.017541	57.011
0.0700	0.21991	0.003848	0.018326	54.567
0.0730	0.22934	0.004185	0.019111	52.325
0.0760	0.23876	0.004536	0.019897	50.259
0.0781	0.24536	0.004791	0.020447	48.908
0.0810	0.25447	0.005153	0.021206	47.157
0.0827	0.25981	0.005370	0.021651	46.188
0.0860	0.27018	0.005809	0.022515	44.415
0.0890	0.27960	0.006221	0.023300	42.918
0.0906	0.28463	0.006447	0.023719	42.160
0.0937	0.29437	0.006796	0.024531	40.761
0.0960	0.30159	0.007238	0.025133	39.789
0.0995	0.31259	0.007776	0.026049	38.389
0.1024	0.32170	0.008236	0.026808	37.302
0.1040	0.32673	0.008490	0.027227	36.728
0.1065	0.33458	0.008908	0.027882	35.866
0.1094	0.34365	0.009400	0.028638	34.919
0.1130	0.35500	0.010029	0.029583	33.803
0.1160	0.36443	0.010568	0.030369	32.929
0.1200	0.37699	0.011310	0.031416	31.831
0.1220	0.38328	0.011690	0.031940	31.309
0.1250	0.39270	0.012272	0.032725	30.558
0.1285	0.40370	0.012969	0.033641	29.725
0.1299	0.40809	0.013253	0.034008	29.405
0.1339	0.42066	0.014082	0.035055	28.527
0.1360	0.42726	0.014527	0.035605	28.086
0.1378	0.43291	0.014928	0.036076	27.719
0.1406	0.44171	0.015526	0.036809	27.167
0.1440	0.45239	0.016286	0.037699	26.499
0.1470	0.46182	0.016972	0.038485	25.984
0.1520	0.47752	0.018146	0.039794	25.130
0.1562	0.49070	0.019161	0.040892	24.499
0.1610	0.50580	0.020358	0.042150	23.725
0.1660	0.52151	0.021642	0.043459	23.010
0.1695	0.53250	0.022565	0.044375	22.535
0.1719	0.54004	0.023208	0.045003	22.221
0.1730	0.54350	0.023506	0.045291	22.079
0.1770	0.55606	0.024606	0.046339	21.580
0.1800	0.56549	0.025447	0.047124	21.221
0.1850	0.58120	0.026880	0.048433	20.647
0.1875	0.58905	0.027612	0.049088	20.372
0.1910	0.60005	0.028652	0.050004	19.998
0.1935	0.60790	0.029407	0.050658	19.740
0.1960	0.61575	0.030172	0.051313	19.488
0.1990	0.62518	0.031103	0.052098	19.195
0.2031	0.63806	0.032418	0.053172	18.807
0.0290	0.65659	0.034307	0.054716	18.276
0.2130	0.66916	0.035633	0.055763	17.933
0.2187	0.68707	0.037565	0.057256	17.466
0.2244	0.70508	0.039549	0.058756	16.883
0.2280	0.71628	0.040828	0.059690	16.753
0.2344	0.73639	0.043153	0.061366	16.296
0.2402	0.75461	0.045314	0.062884	15.902
0.2460	0.77283	0.047529	0.064403	15.527
0.2500	0.78540	0.049087	0.065450	15.279
0.2520	0.79168	0.049876	0.065974	15.158
0.2570	0.80739	0.051875	0.062826	14.863
0.2610	0.81996	0.053502	0.068329	14.635
0.2656	0.83441	0.056704	0.069534	14.381
0.2720	0.85452	0.058107	0.071209	14.043
0.2770	0.87022	0.060263	0.072519	13.790
0.2812	0.88342	0.062104	0.073618	13.584
0.2854	0.89661	0.063973	0.074718	13.384
0.2913	0.91515	0.066646	0.076262	13.111
0.2969	0.93274	0.069233	0.077728	12.865
0.3020	0.94876	0.071631	0.079064	12.648
0.3071	0.96479	0.074131	0.080399	12.438
0.3125	0.98175	0.076699	0.081813	12.223
0.3160	0.99275	0.078427	0.082729	12.088
0.3230	1.01474	0.081940	0.084561	11.826
0.3281	1.03076	0.084548	0.085897	11.619
0.3320	1.04301	0.086570	0.086918	11.505
0.3390	1.06500	0.090259	0.088750	11.268
0.3437	1.07977	0.092778	0.089981	11.112
0.3480	1.09328	0.095115	0.091106	10.976
0.3543	1.11307	0.098590	0.092756	10.783
0.3594	1.12909	0.101449	0.094091	10.628
0.3680	1.15611	0.106362	0.096342	10.380
0.3750	1.17810	0.110447	0.098175	10.186
0.3860	1.21266	0.117021	0.101055	9.896
0.3906	1.22711	0.119827	0.102259	9.779
0.3970	1.24722	0.123786	0.103935	9.621
0.4062	1.27612	0.129590	0.106343	9.404
0.4219	1.32544	0.139801	0.110453	9.054
0.4375	1.37445	0.150330	0.114538	8.731
0.4531	1.42346	0.161242	0.118622	8.430
0.4687	1.47247	0.172536	0.122706	8.150
0.4844	1.52179	0.184289	0.126816	7.885
0.5000	1.57080	0.196350	0.130900	7.639

Unusual Set-up for "ACORN" DIES

This "Acorn" Die is finish-threading a specialaeronautical valve of stainless steel. Accurate? Well, the ½"-20 thread must be so accurate that the threads of the High Speed "Acorn" Die have to be lapped so as to produce smooth, perfect threads within extremely close tolerances. A full thread right to the shoulder was needed, too—another reason for the "Acorn" Die. ☞ Not one manufacturer in a thousand will have an operation like this one. But the fact that only "Acorn" Dies could meet it is genuine proof of their extreme adaptability. ☞ If you need fast threading, accurate threading or super-accurate threading, you need to know more about "Acorn" Dies. Any "G. T. D. Greenfield" Engineer is qualified to answer your most searching questions.

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We Must Win The Game

YOU CAN'T WIN a ball game with a two-man team, or with a four-man team. All nine players must do their level best. And the full efforts of the entire team are particularly needed when you are close to the end of the game and the time is short in which to catch up with or surpass the overwhelming lead of your opponents.

That's exactly where America is today in the defense program—in the last half of the seventh with a string of goose eggs on the scoreboard. And there isn't much time in which to come from behind.

Some of the big companies have taken on tremendous responsibilities. Bethlehem Steel has a billion and a half in defense contracts, largely because it has a good organization and more of the "know-how" than most manufacturers. The automobile industry is handling at least one-tenth of defense production. As in Bethlehem's case, motor car makers have the organization and the resources. They probably know more about mass-production technique than any group in the world.

But we are in a tight spot, late in the game, and we can't depend on a few sluggers to pull us through. The whole team must work like beavers.

A rough estimate places the number of Army and Navy prime contractors at 30,000, and the number of prime contracts at 46,000. Right now over 70,000 sub-contractors are at work on defense orders. That would be enough if the task were a normal one, but it isn't. We are called upon for a superhuman feat, and we must not fail.

More sub-contractors are needed urgently. Plenty of them are to be had if the companies and the projects can be brought together. In an interim report made on the nation-wide survey of industrial capacity supervised by the National Association of Manufacturers, it was found that more than two-thirds of the companies reporting do not have defense contracts, nor are they sub-contractors. Of the firms not making defense goods, about half believe they have the type of machinery convertible to defense production.

What an opportunity to get going quickly and not be dependent entirely on waiting months for delivery of new equipment. And what an opportunity to buy used machinery immediately available and start it working. Such machinery can be secured; defense officials in Washington possess a list of at least 8,000 machines.

The Automotive Committee for Air Defense has a big exhibit of airplane parts at Detroit. The three leading automobile companies are asking their regular sources of automotive parts to be defense sub-contractors on aircraft parts. The Ordnance Department of the Army is setting up munitions parts exhibits in its fourteen procurement districts. OPM will have traveling exhibits of munitions parts touring the various federal reserve districts.

Manufacturers will have ample chance to step up, show what they can do, and take on sub-contracts. But we mustn't waste time! The ninth inning is near at hand, and we must get into action in a hurry if we are to reach our defense goal.

Burnham Finney

GAGING BUSINESS

Expect to ask congress for new defense appropriations. OPM, or other agencies, will take over much of Britain's purchasing in U. S. 95 per cent of machine tool orders have priority ratings

With passage of the Lend-Lease bill, Congress is expected to be asked for new defense appropriations running into the billions, which will still further enlarge the scope of America's armament production effort. At the same time much if not all of Britain's buying in this country, including all machine tools, will be taken over by OPM or other defense agencies from the British Purchasing Commission, according to well-authenticated reports from Washington.

Machine Tools—Establishment of mandatory priorities on machine tools will not seriously affect order books of most machine-tool builders because 95 per cent of existing business carries priority ratings for defense purposes. Main confusion will arise over special single-purpose machines now in process of manufacture for non-defense customers, which may not easily be converted to defense use. Each case will be considered on its merits. The priority order has resulted in a tremendous amount of correspondence between builders and their customers because many of the latter do not know their official status and how to go about determining it. Compulsory priorities are welcomed by numerous machine-tool companies because they no longer will have to discriminate in favor of one customer and against another in deciding upon deliveries. The Government will do that for them. Delivery schedules vary sharply with individual companies, but many builders have few machines to offer during the remainder of 1941. In some cases early 1942 deliveries are being quoted. Through all of the preferential treatment given defense orders, the British have not suffered, Washington having specifically asked the industry to meet all promised deliveries. The British are now placing orders against the second $40,000,000 of so-called "float orders" for U. S. machine tools, while defense officials are widening their purchases of machines for "float" purposes too. To relieve the pressure on the machine tool industry, defense contractors are being urged to buy used machine tools. Despite the talk about a shortage of used machinery, Washington has a list of at least 8,000 machines available.

Shipbuilding—Work already has started on the construction of 51 shipways and other facilities by seven firms which will build 200 emergency cargo ships for the British. Total cost of the facilities will be over $33,000,000. Companies involved are the Oregon Shipbuilding Co., Portland; California Shipbuilding Co., Los Angeles; Houston Shipbuilding Co., Houston, Tex.; Alabama Dry Dock & Shipbuilding Co., Mobile; North Carolina Shipbuilding Co., Wilmington; Bethlehem-Fairfield Shipyard, Inc., Baltimore; and Louisiana Shipbuilding Co., Inc., New Orleans.

Munitions—Production of guns, tanks and other munitions is increasing at a fairly good rate, and should rise sharply before Summer. Some delays may be encountered because equipment for new munitions plants is being diverted to airplane and shipbuilding companies where it is urgently needed. The Ordnance Department of the Army is setting up munitions parts exhibits in its fourteen procurement districts so that prospective subcontractors can see the parts and submit bids. Two hundred amphibian tanks, each capable of carrying 36 marines over land or water, will be built for the Navy Department by General Food Machinery Corp. at Dunedin, Fla.

Railroad Equipment—Equipment makers began February with more new freight cars on order (41,600) than on any corresponding date in 15 years, and continued to book large contracts the past month. Baltimore & Ohio will spend $8,900,000 for 2,400 freight cars. Over 3,000 freight cars were purchased the first three weeks of February. If buying is maintained at the current pace, freight car orders in 1941 may exceed 1940 by 40,000 units. Baltimore & Ohio has put 12,000 mechanics on a six-day, 48-hour week.

Steel—An avalanche of orders indicates that within the next 60 days steel mills may be sold out for the entire year. Formal priorities have not been instituted, but steel makers themselves are rationing steel in certain lines, particularly structural shapes, nickel alloys (including stainless) and galvanized products. Defense orders, of course, are getting preferential treatment. Deliveries range from two to six months.

Grant Far Reaching Power to Canada's Priorities' Director; Control Auto Industry

MONTREAL—Extensive powers have been conferred on the director general of the priorities branch, Department of Munitions and Supply. Under the order, the industrial and transportation facilities of Canada are generally subject to the rulings of the priorities officer whose rulings are immediately effective. He will allocate and determine the transport and delivery of supplies in accordance with wartime needs.

A motor vehicle controller has been appointed with the power to prohibit any person from making or dealing in motor vehicles. John H. Berry, former production manager, Vauxhall, Ltd., an English unit of General Motors, has been named controller; he can license any person or company manufacturing or dealing in motor vehicles, trailers, tires, and parts. The War Exchange Conservation act, passed in December 1940, prohibited importation of new passenger cars. It is likely that this ban will be lifted, imports allowed on a quota basis. Controllers now exist for the steel, oil, power, timber, machine tools, non-ferrous metals, and ship construction and ship repairs.

Armor plate is being made for the first time in Canada. Preparation for large scale production of tanks, in which at least ten Ontario companies will take part, has been made. Tooling up is progressing rapidly. All major parts, except the engines and transmission, including the guns, will be made in Canada.

Government sources indicate that some $3,000,000,000 will be needed this year for the war effort. This is half the national income. About $1,000,000,000 probably will be borrowed from the people; higher taxes are assured.

Government Aids Expansion

Defense Industries, Ltd., DeSalaberry Island, Que., received $18,670,973 from the government for plant expansion and equipment. The company manufactures cannon powder, rifle powder, and higher explosives. Defense Industries, Ltd., Pickering, Ont., received $15,000,000 for the expansion of its ammunition filling plants.

Other government advances were: Chemical Construction Corp. of Niagara Falls, Ont., special chemicals, $14,535,431; Canadian Pacific Railway, Montreal, tanks, $11,700,000; Defense Industries, Ltd., Nobel, Ont., high explosives, $10,572,800; Defense Industries, Ltd., Montreal, small arms ammunition, $8,619,413; Canadian Westinghouse, Ltd., Hamilton, Ont., anti-aircraft guns, $7,951,000; Dominion Engineering Co., Lachine, Que., anti-tank guns, $6,232,000; Canadian Wire & Cable Co., Montreal, brass strips, $5,200,000; Dominion Engineering Co., Lachine, Que., anti-tank guns, $4,435,507; Dominion Bridge Co., Montreal, 2-pounder guns, $4,000,000; Canadian General Electric Co., Peterborough, Ont., gun carriages, $3,045,417; and anti-aircraft mountings, $5,144,632.

THOROUGH SYSTEM OF PRIORITIES IS ESTABLISHED

Last month's request that machine-tool builders confine themselves to defense work has been put on a mandatory basis

WASHINGTON—With an organization pattern fairly well established, Priorities Division of OPM is moving rapidly in the creation of a thorough going system of priorities. Within the fortnight, a set of regulations have been released, the first priorities established for raw materials, the first rationing as between different non-defense orders put into effect, and last month's request that machine tool builders confine themselves to defense work has finally been transferred to a mandatory basis.

This last move was taken to permit dropping non-defense work "without serious consequences . . . by reason of contract obligations to customers desiring the same material for civilian purposes." It is an example of the current tendency to get away from the euphemisms of "voluntary cooperation" that sweetened the first shock of priorities last year. The mandatory-voluntary distinction has become a matter of interest only to lawyers; its real significance is the distinction between priorities on government orders, which have statutory backing, and priorities as between different non-governmental orders, which have no specific basis in law. Actually, of course, the government has available so many extra-legal means of pressure that a voluntary rating is just about as binding as a mandatory one.

Priority System In Two Parts

The new priority regulations, in preparation since the first set was cancelled early in January, split the priority system into two parts. On the one hand is the "automatic" system—the part that can be reduced to rules and formulas. This is administered by the Army and Navy Munitions Board, acting as agent for the Priorities Division of OPM. On the other side is the realm where no simple formulas apply, where each case must be handled on its merits. This is handled directly by priorities division.

Foundation of the automatic system is the so called "critical list." This is a list of scarce fabricated and semi-fabricated military items, ranging from aluminum forgings to battleships. It includes no raw materials. Whenever an order is issued on an item on the list by the Army, Navy, Coast Guard, Maritime Commission, Coast and Geodetic Survey, or National Advisory Committee for Aeronautics, it is automatically granted a priority rating by the Munitions Board. What rating the order gets depends partly on the immediate strategic circumstances but is based, in general, on a formula assigning certain ratings to certain classes of finished goods. Thus orders for .50 calibre machine guns rate A-1-b, orders for airplanes A-1-d.

The automatic system extends also to the first subcontract. When a manufacturer holding a prime contract with a rating from the Munitions Board issues a subcontract for an item on the critical list, he may extend to the subcontract the rating of his prime contract. He follows the now familiar procedure of filling out a form and getting it countersigned by the procurement officer or inspector in charge of his contract. The rating cannot be extended automatically by the subcontractor to his subcontract.

All other aspects of the priority situation are handled on a case-by-case basis by the Priorities Division itself. This includes all raw material priorities, all ratings on subcontracts after the first one, governmental orders for items not on the priority list, ratings on non-governmental orders, including British orders. By far the largest number of ratings to date fall into the automatic system; they are numbered in thousands, while Priorities Division has issued about 1,500.

The first formal priority system for raw materials has been established for aluminum. The practice previously followed for aluminum, and still used with magnesium, zinc, neoprene, structural steel shapes and bars, stainless steel, and potassium perchlorate, was simply to direct the suppliers to meet defense needs first or, in the case of magnesium, to reserve all output for defense. It was left to the supplier to determine for himself what were defense orders. In the case of aluminum particularly, it was possible for the supplier to obtain general guidance from existing priority ratings.

A much tighter system has now been instituted for aluminum—and has set the pattern for similar moves sooner or later on other basic commodities. Aluminum Company and aluminum fabricators must now make delivery strictly in accordance with priority ratings. To cover the large number of cases where orders are obviously to be used for defense but do not now have a priority rating, the producers are directed arbitrarily to assign a temporary rating of A-2 to such orders.

The new system goes even farther in that for the first time the Priorities Division assumes the job of deciding the relative importance of non-defense orders. When all defense needs are satisfied, there will usually not be enough left to meet civilian needs. The producers and primary fabricators are ordered to submit their order books once a month to the Priorities Division. The Division will first check for defense preference and will then indicate which commercial orders are to be filled out of what aluminum remains. It now has the ticklish job of deciding whether the manufacturers of, say, automobiles or kitchenware shall be cut.

Harris & Ewing

New Defense Planning Board—*Will advise OPM on industrial planning. The members are (left to right seated) Harry L. Hopkins; Samuel R. Fuller, chairman; John D. Biggers, director; Admiral W. M. Standley, U.S.N.; and (standing) James B. Carey, secretary to C.I.O.; Robert E. Doherty, president, Carnegie Institute of Technology; William E. Levis, chairman, Owen-Illinois Glass Co.; Major Gen. James H. Burns, U.S.A.; and John L. Pratt, formerly executive vice president, General Motors Corp.*

U. S. TRAINS MILLIONS OF WORKMEN FOR DEFENSE

Government agencies strain to increase supply of essential labor skills as training takes on assembly line proportions

BY RICHARD LA BAN

WASHINGTON—Private shipyards and U. S. Navy Yards constructing U. S. government vessels will require 226,200 additional workers from March 1941 to November 1942. In aviation 203,600 men were engaged in making airframes, air engines and propellers in October 1940. For the industry to deliver according to schedule in the face of increased orders it will have to hire and train more than 250,000 new workers by August 1941. Another 100,000 will probably be added before the summer is over.

The estimates, made by the U. S. Department of Labor and based on business backlog existing in December 1940, are conservative. To date backlogs in these industries have increased; so has the demand for labor. The machine tool industry needs more skilled workers of all grades. So does ordnance, steel and munitions. Both private industry and the U. S. government are rapidly training men to fill the existing gaps in present production. This is how government agencies participating in the labor defense training program help increase our labor supply:

U.S. Office of Education

In June 1940 Congress appropriated $15,000,000 to the U. S. Office of Education for vocational defense training programs. Courses are given to (1) unemployed workers referred by WPA or by local employment service offices, and to (2) employed workers referred by employers and local union groups to prepare themselves for up-gradings in industry. By December 31, 1940 a total of 335,000 persons had been enrolled with more than 800 cities cooperating. Of this number 192,000 were in pre-employment refresher courses; 143,000 in supplementary courses.

It is estimated that over one million persons will be trained for defense occupations by July 1941 in the vocational school program. Enrollments in the regular vocational trade and industrial schools, apart from national defense training, is the highest in history. They total approximately 2,000,000. More than 300 cities have put their vocational schools on 24-hour, 6-day week schedules. The total number that will be served by various vocational educational courses during the coming year will be in excess of 3,000,000.

Such subjects as auto and aviation servicing, drafting, blueprint reading, forging, machine shop practice, pattern making, riveting, welding, sheet-metal working, and ship and boat building are taught. Enrollments are not relegated to Fall and Spring terms as in regular colleges or high schools; a vocational trainee may enroll any time and finish as fast as his aptitude or previous experience enables him.

It is assumed that from 200 to 400 hours will be the usual period of training. Some will be ready for employment in less than 200 hours; some will require more than 400 hours. Training courses in vocational schools are given after the regular school hours; classes run from 4 p.m. to 4 a.m.

Engineering Defense Training, supervised by the U. S. Office of Education, has been set up to meet shortages in engineering personnel with specialized training in essential fields. Congress appropriated $9,000,000; it will be spent by June 1941. By that time 848 courses will be given in 126 colleges in 47 states (not Montana), the District of Columbia and Puerto Rico. Present facilities will care for 66,414 students. The courses give intensive instruction in a narrow field to prepare the trainee for specific duties in as short a time as possible—normally between two to six months.

Requirements for admission to the defense courses vary with the difficulty of the subject. Some are open to high school graduates; others require from two to four years of engineering education. There are no age limits, but applicants will not be accepted unless they are employable in defense work. Selection of students is entirely in the hands of the engineering schools, and requests for information about, or admission to, any course should be sent directly to the institution concerned; every State University except Montana is participating. Accepted students will have the cost of their instruction paid by the government, but will be required to maintain themselves and buy needed textbooks.

Among courses given are: machine design, engineering drawing, production engineering, tool and die design, airplane and its engine, ordnance inspection, welding, ship construction, metallurgy, tool and fixture design, materials inspection and testing, explosives, and aeronautical engineering.

National Youth Administration

For the past five years Congress has appropriated funds for the National Youth Administration's program to employ out-of-school youth. From June 1940 to June 1941 over 500,000 young people will have part time jobs which serve as a training ground for employment in industry. The NYA operates over 5,000 production shops in 2,903 of the 3,072 counties in the U.S., as well as in Alaska, Puerto Rico, the Virgin Islands. Shops include metal-working units, radio, shipbuilding, welding, sheet metal, forging, aircraft, electrical, and automotive. Opportunities to learn the use of hand tools and power-driven machinery are present. In addition arrangements have been made whereby NYA youth may secure supplemental training in such courses as blueprint reading, shop arithmetic, and machine shop practice. This schooling is offered gratis by the state vocational system, backed financially by the U.S. Office of Education.

When a NYA youth has secured enough experience in industrial operations essential to defense industries, he is often and quickly employed. He must take a job when it becomes available. Any young men or women between the ages of 15 and 24 who are out of school, unemployed, citizens of the U.S., are eligible for a job with NYA. Application may be made in person or by letter to the nearest NYA office or to the National Youth Administration, Washington, D. C.

Works Progress Administration

From July through December 1940 some 26,000 WPA workers received vocational training in nearly 500 towns and cities in 47 states, the District of Columbia, Hawaii, and Puerto Rico. Of these, 12,000 already have jobs in private industry.

Vocational classes, which began last July, are sponsored by the U.S. Office of Education. Instruction is provided by the Department of Education in the states. Many expert craftsmen from private industry have been drafted as part of the teaching personnel. The training program is composed of (1) refresher courses for workmen who were formerly employed in industry, and (2) pre-employment training for men who have had no experience in industrial production. The refresher courses, given for six to eight weeks, include such subjects as lathe operation, drill press operation, riveting, welding. In pre-employment training, six to eight weeks is not sufficient time to train men to operate complex machines. However, within this period, trainees are given basic training in machine operations of various types. After 100 hours of lathe training a man may be prepared for simple work of this nature with a minimum of additional plant training or experience. Among courses given are: auto and aviation servicing, machine shop practice, welding, drafting, pattern making, sheet metal work, foundry, forging, ship and boat building. Opportunities are present to learn the use of hand tools.

Federal Committee on Apprenticeship

U.S. industry has long engaged in programs intended to train young men to become all-round skilled workers. So far as can be determined there are between 100,000 and 150,000 apprentices in training in the U.S. William F. Patterson, Chief of Apprenticeship, U.S. Department of Labor, told AMERICAN MACHINIST that 1,500,000 apprentices should be in training to supply our industrial needs.

Congress has assigned the apprenticeship unit of the Division of Labor Standards, U.S. Department of Labor, the job of promoting apprenticeship in industry. Its present field staff consists of more than 100 men who are distributed throughout the U. S., particularly in strategically major industrial areas. These representatives cooperate with both employers and labor, assist in negotiations between parties concerned, aid the establishment of apprenticeship training systems that meet with certain basic criteria approved by the Federal Committee on Apprenticeship.

At the end of 1940 there were 750 approved apprenticeship systems in 34 states; this contrasts with the 433 systems in 28 states reported for 1939.

Civil Service Commission

The U.S. Civil Service Commission maintains 5,000 local boards in the U.S. for the purpose of recruiting skilled workers for the government services of War, Navy, Maritime, and U.S. Civil Aeronautics Authority. All first and second class post offices throughout the U.S. have local Civil Service boards; in 40,000 third and fourth class post offices bulletins are posted telling of needs for workers in the government services.

Once an employee joins the Civil Service ranks, whether in essential defense production or as a census taker, he can be moved up to a job requiring greater skill and greater pay. However, the Service maintains no up-grading courses as such.

All applicants must be citizens of the U.S. Other than that qualifications differ for each job; these may be ascertained by writing to the Civil Service Commission, Washington, D. C., or the nearest local board.

Civilian Conservation Corps

More than 300,000 young men are enrolled in the Civilian Conservation Corps and are acquiring improved work habits, a knowledge of tools. About 2,175 CCC enrollees have been accepted for training by the Maritime Commission in the Merchant Marine Service; most of them are being trained for deck and engine room duties. Those that pass the course are eligible for membership in the merchant marine naval reserve if they pass the Navy's requirements.

Set Maximum Prices for Used Machine Tools; Dealers Must Send Reports to Washington

WASHINGTON—Maximum prices for used machine tools have been set by Leon Henderson. Effective March 1, dealers must submit to Henderson weekly reports of machines in stock, monthly reports of machines sold by or through them or purchased by them as agents. Prices, classified according to date of manufacture and condition of machines, are based on current prices for 1941 models.

The schedule:

Model Year	Rebuilt and Guaranteed	Others
1936 and after.....	95%	75%
1930–1935 inclusive..	90%	70%
1920–1929 inclusive..	80%	60%
1919 and before.....	70%	50%

The rebuilt and guaranteed classification applies only to rebuilt and tested machines which carry a 30-day warranty of satisfactory performance. Henderson emphasizes that these prices are a ceiling; sales should be made below them. The order includes lathes, boring mills, milling machines, drill presses and all machines for cutting, abrasing, shaping, forming and joining of metal.

Establishment of used machine-tool price schedules did not come entirely without warning. OPM has worried about used machinery prices getting out of hand, has been particularly concerned about prices charged the British. In certain cases prices asked for machines 20 to 30 years old have been considerably above prices of new machines.

Bureau of Employment Security

The Bureau of Employment Security, Social Security Board, acts as a clearing house for most of the government agencies engaged in labor training for national defense. By means of 1,500 full time branch offices and 3,000 part-time offices the Bureau of Employment Security conducts country wide surveys to determine demand and supply of various occupations in the U.S. In the manner of a Gallup poll, these surveys are made every 60 days, enable the Bureau to forecast how many machinists, welders, riveters, etc. must be trained to meet the demands of employers. Hence before the NYA, the U.S. Office of Education, the WPA, the CCC, and the Civil Service embark on a program of labor training, these agencies confer with the Bureau of Employment Service in order to determine the types of workers and skills needed. Of course, other agencies, notably the Department of Labor, survey the labor market and advise in training.

After men complete training courses in NYA, vocational schools, engineering colleges, WPA, private schools or industry, the Bureau will help them get a job. The Employment Service classifies job requirements and workers' qualifications; it matches these up and instructs workers as to where a job is available for which they are qualified.

Placements have been huge. In December 1940 the Bureau secured jobs for 378,000; private employers took 298,000. For the entire year the Bureau filled nearly 3.8 million jobs, of which 3.2 million were in private employment.

Training-Within-Industry

Training-Within-Industry, an advisory council made up of men in industry, works as a part of the Labor Division of the National Defense Advisory Commission. Its service is designed to assist defense industries to meet their man-power needs by "training-within-industry" each worker to make the fullest use of his best skills up to the maximum of his individual ability, thereby enabling production to keep pace with defense demands.

In effect the council is a bureau of experts banded together in order to answer questions of manufacturers on any conceivable subject from labor training to production problems. Manufacturers do not obligate themselves by asking the board for help; the service is free and no administrator or adviser is allowed to dictate policy to any firm. For example, the Glenn L. Martin Co. has found this service very useful. Personnel Director Seaman thinks it offers a wealth of information to all defense industries. He is enthusiastic in his recommendations.

To date inexperienced firms wishing to have some information have been responsive to the service offered. Old established firms who have succeeded without being forced to use the most efficient methods do not ask for aid. Biggest reason is that they fear governmen supervision, possibly in the form of reports. The agency tries not to take the initiative in offering advice but does make the first contact with firms known to be amenable.

To ascertain the best methods devised for the development of production workers, the establishment of trades apprenticeship, and the development of supervisors, inquire from C. R. Dooley, director, Training Within Industry, Advisory Commission to the Council of National Defense, Washington, D. C., or at the 22 regional offices set up for this purpose. These are: Boston, Hartford, New York City, Newark, Philadelphia, Baltimore, Canton, N. C., Atlanta, Cincinnati, Pittsburgh, Cleveland, Detroit, Indianapolis, Chicago, St. Paul, St. Louis, Houston, Denver, Los Angeles, San Francisco and Seattle.

U. S. AIRCRAFT ENGINE PRODUCTION INCREASES

Plane production in January totaled 1,036. Engine production reached 2,400 while 600 of these were shipped to Great Britain

BY ROBERT COLBORN

WASHINGTON — Increasing engine production is still among the most urgent objectives of the defense program. But engine production is steadily catching up with plane production. In fact, if all American engines went into American planes, there would be more than enough. Plane production in January totalled 1,036 (36 commercial planes, about 600 trainers, about 400 combat types). An average of two engines per plane is required, or about 2,000 engines. Actual engine production was about 2,400. However, some 600 engines were shipped to England for installation in British planes, leaving a deficit of 200 engines.

This picture is a little over-optimistic. The engines going abroad in crates are nearly all of the high powered combat types, which results in the engines available here not always matching up with the planes which need them. Moreover, it does not allow for the fact that in a few cases plane production is being deliberately held down to prevent creation of "glider lines" of planes without engines.

This country now is building each month more than 900 of three engines equal in performance to any production models in the world, one of which cannot be matched abroad. Pratt & Whitney is building the only 2,000-hp engine in assembly line production. This is an air-cooled radial engine with 18 cylinders arranged in two banks. Production rate on this R-2800 is 60 a month. It is scheduled to reach a peak of 350 a month by June. In August Ford will start turning out the same engine under license and should reach 300 a month by the end of the year. At about that time, Buick will begin producing, also under license, and will reach 500 a month sometime in 1942. Thus a 1942 total of 1,150 is scheduled, apart from any further expansion that may be undertaken.

The other big air-cooled radial is made by Wright. This is a 1,700-hp. job of 14 cylinders in two rows; it has been in production longer than the P & W, and 500 a month are now being turned out. Studebaker is to start building these late this year, with an ultimate output of 500.

Wright is adopting a policy of concentrating its production on its big engine, farming out the smaller units in its line. Pratt & Whitney, less inclined to sub-contracting, will unquestionably continue to build its 1,000-hp Twin Wasp (which is still a combat engine) and perhaps its Wasp and Junior Wasp trainer engines.

The big radials are being used in bombers, Navy fighters, and will be used in one Army pursuit, the Republic P-47. For most of its pursuit the Army relies on liquid cooled engines, which means for the present the Allison V-1710. This a 12-cylinder inverted Vee engine. Allison (a G.M. subsidiary) is turning out 350 to 400 a month of the 1,090-hp job and is getting ready to switch to an improved model developing 70 more horses and weighing 30 lbs. less.

Another source of liquid cooled engines will come in during the year. Packard will turn out the first hand assembled units of the Rolls Royce Merlin within a few months, and will reach full production in the Fall. The Merlin is a British design similar generally to the Allison.

Prospects for the future, obviously, are not simply a matter of climbing production figures. Design and performance will change too. U.S. air-cooled engines now lead their field, and no radical changes are in prospect beyond a gradual increase in power. A 2,300-hp job is already in the experimental stage.

As regards liquid cooled engines, the situation is more uncertain. The low frontal area of this type, reducing the air resistance both of the engine itself and of the skinnier ship into which it can be built, has enabled it to perform commendably alongside radial engines of much greater power. But war experience has led to continual loading of planes with more shooting iron, which demands more beef in the engine. Engines of markedly greater power are being called for.

Hand-built specimens of one such engine have been flown. This is Rolls Royce's new 1,900-hp. Vulture, a 24-cylinder X engine which is essentially two Merlins on a common crankshaft. Real quantity production of this engine is believed to be at least a year away. What Packard will do about the new British design has not yet been finally decided. Defense officials are not inclined to sacrifice early production of the Merlin to switch over to the still untried Vulture. There are indications that Packard will do tooling and order parts for the Vulture while running off its order of 9,000 Merlins. Presumably Packard is arranging its tooling for the Merlin as to permit ready conversion to the Vulture.

Export of Machinery During December, 1940

	December 1940	November 1940	December 1939
Electrical machinery and apparatus	$9,785,539	$10,571,762	$10,866,114
Power-generating machinery, except electric and automotive	2,119,427	2,054,421	1,612,727
Construction and conveying machinery	2,531,130	2,974,860	2,399,993
Mining, well, and pumping machinery	4,262,307	3,758,680	4,928,431
Power-driven metal-working machinery	28,753,334	27,413,932	12,821,234
Other metal-working machinery	815,718	911,038	477,249
Textile machinery	768,239	690,189	1,021,409

Metal-Working Machinery

Engine lathes	$1,549,800	$2,173,214	$778,015
Turret lathes	1,828,270	1,765,503	881,500
Other lathes	1,882,929	1,952,385	244,875
Vertical boring mills and chucking machines	1,123,502	1,050,307	770,439
Thread-cutting and automatic screw machines	1,784,117	2,005,015	801,006
Knee and column type milling machines	3,406,763	2,742,799	717,412
Other milling machines	3,285,381	3,310,786	1,025,706
Gear-cutting machines	679,808	466,281	466,327
Vertical drilling machines	595,109	436,143	196,777
Radial drilling machines	303,685	271,162	159,802
Other drilling machines	806,223	949,514	194,583
Planers and shapers	679,189	569,335	581,974
Surface grinding machines	431,581	434,342	162,935
External cylindrical grinding machines	1,076,900	579,676	424,175
Internal grinding machines	1,040,329	354,789	340,795
Tool grinding, cutter grinding, and universal grinding machines	1,030,677	1,197,733	546,692
Other metal-grinding machines and parts	1,009,180	1,376,574	448,142
Sheet and plate metal-working machines and parts	1,436,538	637,181	406,952
Forging machinery and parts	1,350,663	757,854	671,868
Rolling-mill machinery and parts	1,193,597	1,653,819	1,113,354
Molding machines	12,103	15,114	22,239
Other foundry equipment and parts	317,011	163,481	80,181
Other power-driven metal-working machinery and parts	1,912,531	2,542,871	1,779,498
Pneumatic portable tools	103,749	93,175	126,248
Other portable and hand or foot-operated metal-working machines and parts	155,251	161,117	129,309
Chucks for machine tools	52,773	50,649	44,659
Milling cutters, machine-operated threading dies and tape, and similar machine-operated metal cutting tools	211,553	260,451	89,206
Other metal-working machine tools and parts	292,392	345,646	87,827

Machinery Exports Hit Record for Third Month

WASHINGTON—Shipments of industrial machinery during December were valued at $46,273,141, establishing a new record for the third successive month. Exports of all power-driven metal-working machinery amounted to $28,763,334 in December.

INSIDE DETROIT

Automotive steel supplies move toward critical stage; it may force curtailment of passenger car production. Substitutions in specifications are being made. G-M pools steel purchasing

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Supplies of automotive steels are moving toward a critical stage. There is some possibility, acknowledged in both automotive and steel circles, that passenger car production faces a forced curtailment in the next 60 to 90 days, through inability to get all the tonnage desired.

Several factors have brought about this situation. Tightness has developed in supplies of alloying constituents; manganese and chromium in particular, and to some extent in nickel. Steel mills can't operate indefinitely at capacity. When a breakdown occurs, there is currently no slack in schedules to permit making up lost time. As a consequence, deliveries are less certain, and complaints are increasing that material is not arriving when specified. Assembly lines haven't faltered to date from delayed steel shipments, but on the other hand it is acknowledged that steel in shipment to or stored in customer's plants is hardly sufficient for the present assembly rate. It is impossible to order steel now for delivery earlier than July or August.

Anticipate Steel Shortage

To some extent the uneasy situation in respect to steel supplies is a creature fashioned by the automobile industry itself. In anticipation of a steel shortage, orders were placed early with the steel industry for the balance of the 1941-model run, instead of for the first quarter only. But sales pressure was not relaxed. Every device was employed to encourage the public to buy new cars. As a result sales continue at record-breaking proportions. The strain upon sub-normal field stocks caused production schedules for January to be raised. Operations continued unabated through February. As a consequence, January saw an output of 524,000 units and February set a new record for the month, in excess of 500,000. Suppliers are under pressure to support production at higher levels in March, April and May. Monthly outputs around 550,000 units are in the wind. Of course these depend upon whether the public has been over-sold and whether steel supplies hold up.

With more than 6,000,000 people dependent upon the automotive industry directly or indirectly for their livelihood, motor-car manufacturers conceive it their duty as well as a matter of good business to maintain production. Steps are already under way to conserve zinc for national defense purposes, (AM—Vol. 85, Page 130g) but the bigger job is immediately to make substitutions in steel specifications to relieve shortages in alloying constituents.

In the program to conserve the usage of manganese, chromium and nickel, the industry fortunately possesses a large background of experience in developing steels. Great strides have been made in recent years toward using cheaper, lower-alloy materials and carbon steels. This work has been assisted by concurrent developments in steel mill practice and heat treating. Further intensive studies are now being made to simplify the number of steels which the steel industry will be asked to make, and to offer substitutions in analysis, especially with a view to conserving manganese, a substance almost exclusively imported.

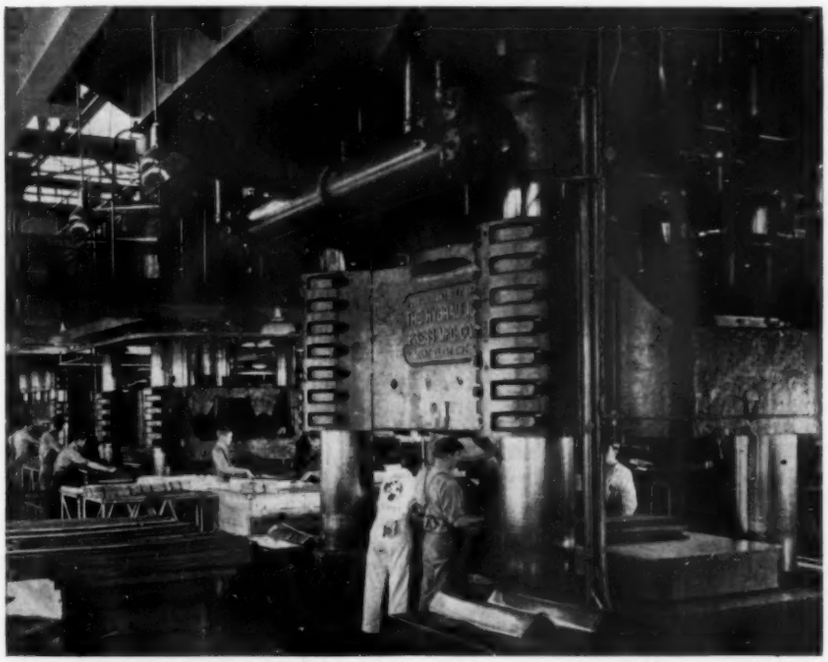
General Motors has just taken a long stride by setting up machinery to pool all steel purchasing by its various divisions. Fewer steel analyses and less alloy consumption are expected to result. Furthermore, the corporation will endeavor to switch from manganese steels, which it uses for structural elements in large degree, to low-chromium steels.

Other motor car companies will be affected according to the preferences which they have built up over the years. Chrysler pioneered the use of molybdenum steels (Amola) for structural elements.

The supply of aluminum scrap used in making aluminum pistons has given concern to manufacturers who have built their engines around light weight piston construction. Scrap supplies showed a recent tendency to dry up in an unaccountable manner. Investigation by the government disclosed that hoarding was going on, and that resumption of normal releases of scrap to the market would alleviate the situation. While not certain that enough scrap material will be available next year, manufacturers using aluminum pistons are of the opinion that a switch to cast iron or cast steel pistons will not be necessary.

1940 AUTO EXPORTS SOAR

DETROIT—Exports of automotive products during 1940 valued at $273,535,536, an increase of $7,500,000, or 2.8 per cent, as compared with the 1939 figure of $266,024,944, is reported by the Motive Products Div., U. S. Department of Commerce. Shipments of trucks and bus chassis totaled $88,201,907, a gain of 26.8 per cent as compared with 1939.



Under Pressure For Defense—*Aviation's largest line of hydro-presses was developed at Douglas Aircraft Co., Santa Monica, Calif. These presses, used for the Guerin process, are in use throughout the aircraft industry In one operation they cut and form aluminum alloy sheets into airplane parts*

A Philadelphia Story — ASTE Chapter Holds Third Annual Exhibition and Dinner

Philadelphia—*More than 1,000 tool engineers, production executives, master mechanics and tool designers attended the third annual exhibition and dinner sponsored by the Philadelphia chapter of the American Society of Tool Engineers, Feb. 15. Among those attending were: A. H. d'Arcambal, (above) president of the Society; Paul W. Frankfurter, Sr., chairman of the local chapter; W. C. Gray and Frank Sheeley, New York-New Jersey chapter; Frank W. Curtis, chairman, Springfield chapter; William Stegmerten, Westinghouse; Conrad O. Hersam, secretary of the ASTE; and Frank R. Crone, ASTE treasurer. Thirty manufacturers and distributors had products on display.*

More Than 13,000 Men Trained by General Motors for Defense Jobs; Aid Army and Navy

DETROIT—General Motors Corp. is operating one of the largest labor training programs ever undertaken by U. S. industry. More than 13,000 men are being trained directly in the company's 40 plants. The General Motors Institute at Flint serves as general staff for a company which has had 21 years experience in labor training. Vice president B. D. Kunkle is in charge of personnel.

Key factor in the program is that trainees are taught specific operations only; instruction periods are short, turnover is large. Lathe, milling machine operators, drill press hands, welders, tool grinders, set-up men, foremen, technicians, and instructors are given intensive training. Assistance is also given to Army and Navy in teaching men to service General Motors' products in use. Most of the trainees range in age from 18 to 25; a majority are without previous experience in industry. Those with some shop training are given preference.

In initiating a defense project, general practice has been to start with experienced men drawn from regular production departments. These form the nucleus of the defense group. Trainees are put to work with them while other trainees are run in tc refill vacated places in the departments.

Methods of training used in the 40 plants vary to fit local needs and problems. In some plants trainees are taught "on the job", working either as assistant to an experienced operator or alone on a machine under the general supervision of a set-up man. Under both methods jobs are broken down into component parts so that trainees can be started on simple operations. Those that show promise are upgraded to more complex machines to make way for new trainees at the bottom.

Another method utilizes the "vestibule school" by means of which trainees are given preliminary instruction on machines set aside for that purpose before they enter a manufacturing department. Some plants instruct trainees by the group method in which small groups of trainees are placed under individual instructors who give their charges one hour of classroom work a day and supervise them in the shop the rest of the time.

Marines Adopt the Garand

WASHINGTON—The U. S. Marine Corps has adopted the U. S. Rifle, calibre .30, M-1, (Garand Rifle) following exhaustive tests. Experiments with the rifle were conducted at the Marine Corps base at San Diego, Calif.

Electric Truck Bookings

CHICAGO—Over 260 units of electric trucks and tractors were booked in January; this is a 222 per cent increase over January 1940. Bookings were not as high, however, as in December 1940 when a peak was reached, as indicated by the Industrial Truck Statistical Association.

Carborundum Has Its Fiftieth Birthday; Wide Application of Abrasive Continues

NEW YORK—March 1941 marks the fiftieth birthday of carborundum, a product which has had revoluntionary effects on the metal working industries.

In the course of some experiments on the impregnation of clay with carbon at high temperatures in a crude electric furnace, Dr. Edward G. Acheson in March 1891 discovered that he had produced a very few crystals of a substance which he found would not only cut glass, but would abrade a diamond.

He thought at first that the substance was a combination of carbon and the aluminous oxide abrasive which in its natural form is known as corundum. He called it "Carborundum" and registered the trade mark. The product made by the The Carborundum Company is still sold. Some time later chemical analysis showed that the substance was really silicon carbide, a substance unknown in nature.

Dr. Acheson formed The Carborundum Co. at Monongahela City, Pa. The price of electric current there was so high that the cost and consequently the selling price of Carborundum was too high to permit of volume sales.

The Carborundum Co. built a plant at Dusseldorf, Germany in 1906, at Manchester, England, in 1913, at Niagara Falls, Ont., during 1916-1917, and at Shawinigan Falls, Quebec, during 1917-1918.

Dr. Frank J. Tone has been president of The Carborundum Co. since 1919. He was the first works manager. Henry P. Kirchner was made works manager in 1927 and vice president in 1938. Charles Knupfer was made general sales manager in 1936 and vice president in 1938.

Following Acheson's discovery of silicon carbide, Charles B. Jacobs invented a process for making aluminum oxide in the electric furnace. The Carborundum Co. manufactures both abrasives in several forms.

WATCHING WASHINGTON

Strikes in defense industries are on the increase. Six anti-strike bills are pending in Congress. Many administrative officials want to use conciliation rather than prohibitive law

By BLAINE STUBBLEFIELD

WASHINGTON—The strike scoreboard has been showing increased defense production shutdowns lately. A half dozen anti-strike bills are pending in Congress. The House Judiciary Committee is calling headline witnesses to testify on the subject.

Number one among those witnesses is W. K. Knudsen, Director General of OPM. "You can't make it a crime to strike," he said. "I feel that the amount of stoppages so far has not interfered with the defense program. Of course, if the situation were serious, then I might change my attitude. I am not in favor of any strong measures."

Number two witness was Sidney Hillman, Associate Director General, who pointed to aluminum as a typical case, in which, he said, less than one-sixteenth of one per cent of time idle was due to strikes. He said that less than two hours per worker were lost due to strikes in 1940; that during the first six months of the present defense effort, there were 47 per cent less men involved in strikes than when the U. S. was at war 24 years ago.

It is said by anti-labor men that Mr. Knudsen agrees with Hillman on strikes because Hillman gives ground to industry in the national interest. A high official who sees Knudsen almost every day tells AMERICAN MACHINIST that Knudsen feels just as he said; that he wants to use conciliation rather than prohibitive law. He says that Knudsen has no political battles to win; he wants to apply man hours to jobs.

The attitude of other federal officials was expressed in letters to Rep. Hatton W. Sumners of Texas, chairman of the Judiciary Committee, who had asked for statements. E. R. Stettinius, OPM director of priorities; the Secretary of War, and the Attorney General wrote that they saw no need for strike legislation. Navy Secretary Knox wrote that remedial measures are important to the Navy and other agencies. This writer learned, however, on good authority, that the Navy's opinion was based on a report that classified many minor stoppages as strikes.

Persons outside of Washington might easily fail to grasp the significance of the Sumners hearings. In the first place, it is probable that Rep. Sumners himself does not expect any definite proposals of legislation at this time. Committee hearings are often staged by groups in Congress as an effective threat against something they know they can't legislate against. In all probability these hearings will be discontinued, with the threat of resumption left hanging. At this time the President does not seem to have authority to stop strikes, unless he could do it under the plant confiscation law. This committee is waving the caution light in the name of Congress.

Quite likely even the hearings would have got small support except for the fact that many persons, in order to get a defense job, have been forced to plank down union fees to become eligible. This irks even the newest of New Dealers. It was not casually that Westbrook Pegler, the anti-labor-racket columnist, was called in. He said unions are supposedly voluntary but actually they are compulsory; once men are forced into them, no law can touch them.

Outstanding causes of the strikes are: demands for more pay, and demands for closed shop. The latter is giving the government a headache. Majority unions often feel that the minority union in a given plant is teaming with the management. Jealousy between CIO and AFL is a constant irritant. There is no remedy in sight, except conciliation.

This all adds up to smooth sailing for industry and labor. But there are two possibilities to watch. If labor goes too far the Administration will call for legislation, or, if emergency comes, simply take over. And, for its cooperation, labor, especially CIO, is likely to demand new "gains" with the return of peace.

OPM used this method in an attempt to end the CIO strike at Bethlehem Steel Corp., Lackawanna plant. Although no decision was reached by press time it seemed that settlement would be made by conciliation.

May Investigate Defense Purchasing

Seven or eight resolutions in Congress call for various kinds and degrees of investigation of the defense purchasing program. Some sort of inquiry almost certainly will be made, probably by the Rules Committee. House Miliary and Naval Affairs Committees, or possibly a special committee, have also been suggested for the job.

Legislators remember the tragic mistakes of the World War. They quote the one about the War Department buying 195,000 branding irons to brand 290,000 horses. They are told by Henderson's price control office that some branches of the Services, with unlimited cash, are going on spending sprees, grabbing everything in sight. They are told that some collusion and favoritism are growing out of the negotiated purchase system.

As in the case of the defense strike hearings, probably nothing drastic will come out of the injury. It will be expected to serve as a threat and a check on wrong-doers. It will cover all defense activities, including contracts, loans, expenditures, delays. There is not now any effective check on War and Navy purchasing; they make up their orders, and the Defense Commission merely tells them where and when they can get it, not whether they need it.

PATENT INFRINGEMENTS

WASHINGTON — A bill which would make it impossible to hold up defense production by getting a court injunction to stop infringement on patents has been introduced by Rep. Charles Kramer, chairman of the House Patent Committee. It would apply only to articles certified by the Patent Commissioner as essential to defense, and only for the duration of the emergency. Sole recovery for a patent owner under this proposed law would be "reasonable compensation." Another bill would prevent publication of strategic inventions abroad. Both are supported by the Administration.

Lay Keels This Month

First keels of the 200 "pointed box" ship program to relieve British commerce will be laid in March by the Maritime Commission. Contracts are nearly all placed and work is in progress on the 51 ways for the program, located in Baltimore, Portland, Oreg., Los Angeles, Houston, Wilmington, Mobile, and New Orleans.

When the Maritime Commission mentioned the assembly of component parts, it meant machinery and equipment; not hull structure. Hulls will be built in the usual way, but with much more than the usual amount of welding. The amount of welding will differ in different yards. Some yards will rivet only the frame and weld the plate.

Some of these ships will be delivered this year. The balance will be delivered during 1942. They are 10,400 tons, with 2500 horsepower reciprocating engines, and oil-burning water-tube boilers. They are very similar to the 60 ships being built for the British.

FORD'S PLANT SPEEDED

DETROIT—Without waiting for final approval from Washington on facilities and supplies contracts, the Ford Motor Co. is understood to be hurrying its four-motor bomber program by proceeding in two directions: 1) Completion of redesign of the model B-24D for manufacture by the sub-assembly system, and 2) preparing plans for the first units, costing over ten millions, in a plant that eventually may comprise 500 by 5000 feet and be capable of producing completed ships. This plant will be located on a large tract near Belleville, Mich.

Mandatory Priorities Set For Machine Tools

WASHINGTON—Machine-tool builders and aluminum producers were put under a mandatory priority status beginning Feb. 24 by the Priorities Division of OPM. In letters sent out by E. R. Stettinius, Jr., director of priorities, both industries were instructed to apply a preference rating of A-2 on all defense orders not already bearing a higher rating.

Mr. Stettinius asked machine-tool people to give preference to defense orders over non-defense orders so far as necessary to comply with delivery dates. He told them to apply to his office in Washington in case they have difficulty in determining whether any particular orders are for defense purposes. If the machine-tool builder feels that any non-defense order must be given a prior status, he is asked to communicate the facts to the Priorities Division. The order expires May 31, 1941.

What Mr. Stettinius' order did was to make compulsory the instructions transmitted to machine-tool builders Jan. 31 not to fill any contracts after the end of February except those going to defense industries.

Because of the vital necessity for rapid expansion of the machine-tool industry itself, many machine-tool builders have geen given a blanket priority privilege to acquire machinery and other equipment. This blanket status will expire March 31, but can be extended if necessary. Gage makers also were given a blanket rating.

Several reasons are assigned for priority ratings on aluminum. One is that large quantites of scrap aluminum have been withheld from the market. An effort has been made to ease the situation by asking companies with scrap to hold it for later return to the original source of supply. Because of the step-up in the British military program, the United States was completely shut off in January from the 3,000,000 lb. of aluminum ingots normally imported from Canada. Moreover, aluminum fabricators are increasing their capacity and must have larger working stocks.

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $100,000)

Source	Agency	Commodity	Amount
Standard Pressed Steel Co., Jenkintown, Pa.	War	Small arms ammunition	$564,199
Timken-Detroit Axle Co., Detroit, Mich.	War	Artillery material	120,131
The Denison Engineering Co., Columbus, Ohio	War	Presses	180,525
Logansport Machine, Inc., Logansport, Ind.	War	"	250,830
Watson-Stillman Co., Roselle, N. J.	War	"	363,075
California Steel Products Co., San Francisco, Calif.	Navy	Buoys	149,546
Bender Body Co., Elyria, Ohio	War	Trailers	559,576
Fate-Root-Heath Co., Plymouth, Ohio	War	Locomotives	250,500
Trailer Co. of America, Cincinnati, Ohio	War	Semi-trailers	995,760
Electric Wheel Co., Quincy, Ill.	War	Trailers	166,200
D. W. Onan & Sons, Minneapolis, Minn.	War	Generator sets	237,700
General Electric Co., Erie, Pa.	War	Locomotives	533,925
Davenport Besler Corp., Davenport, Iowa	War	"	298,450
Variety Aircraft Corp., Dayton, Ohio	War	Stand assemblies	198,000
Walter Kidde & Co., New York, N. Y.	War	Cylinder assemblies	139,535
Blackhawk Manufacturing Co., Milwaukee, Wis.	War	Jack assemblies	264,225
Schwitzer-Cummins Co., Indianapolis, Ind.	War	Cartridge cases	357,875
National Cash Register Co., Dayton, Ohio	War	Artillery ammunition components	119,948
Trackson Co., Milwaukee, Wis.	War	Small arms material	100,791
McKiernan-Terry Corp., Dover, N. J.	War	Staking machines	128,846
General Steel Castings Corp., Eddystone, Pa.	Navy	Plates	120,840
Commercial Engineering Co., Washington, D. C.	Navy	Motors	106,000
The Buda Co., Washington, D. C.	Navy	Generator sets	421,680
Pullman Standard Car Mfg. Co., Butler, Pa.	War	Forgings	1,134,000
Colorado Fuel & Iron Corp., Pueblo, Colo.	War	"	4,536,000
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.	War	Pistols	246,037
Peco Mfg. Corp., Philadelphia, Pa.	War	Fuse bodies	360,000
Budd Wheel Co., Detroit, Mich.	War	Burster casing	8,224,140
General Motors Corp., Lansing, Mich.	War	Shell	9,505,600
Revere Copper & Brass Inc., Baltimore, Md.	War	Cartridge cups	361,350
American Brass Co., Waterbury, Conn.	War	Cartridge disks	163,340
Chase Brass & Copper Co., Inc., Waterbury, Conn.	War	" "	715,644
Warner & Swasey Co., Cleveland, Ohio	War	Lathes	147,623
Morris Machine Tool Co., Cincinnati, Ohio	War	Drills	120,255
Northern Pump Co., Minneapolis, Minn.	Navy	Pumps	174,312
Haves Industries Inc., Jackson, Mich.	War	Wheel & brake assays	1,275,115
Bell Aircraft Corp., Buffalo, N. Y.	War	Adapter assys.	249,375
Douglas Aircraft Co., Inc., Santa Monica, Calif.	War	Airplanes	399,924
Bendix Aviation Corp., Bendix Products Div., South Bend, Ind.	War	Wheel and brake assys.	235,526
Bendix Aviation Corp., Eclipse Aviation Div., Bendix, N. J.	War	Inverters	267,000
Star Machine Mfr's., Inc., New York, N. Y.	War	Switch assys.	207,150
Bendix Aviation Corp., Bendix, N. J.	War	Starters	5,663,167
Goodyear Tire & Rubber Co., Inc., Akron, Ohio	War	Wheel and brake assys.	4,417,848
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	War	Turret assys.	5,153,975
Greenport Basin & Const. Co., Greenport, N. Y.	Navy	Minesweepers	631,400
United Aircraft Corp., Hamilton Standard Propellers Div., East Hartford, Conn.	War	Blade assys.	280,474
Lake Superior Shipbuilding Co., Superior, Wis.	Navy	Barge	2,184,448
Gen. Motors Corp. (Delco Appliance Division), Rochester, N. Y.	War	Control equip.	2,589,809
National Supply Co., Philadelphia, Pa.	War	Diesel engines	271,152
Biederman Motors Corp., Cincinnati, Ohio	War	Truck-tractors	346,080
Fargo Motor Corp., Detroit, Mich.	War	Trucks	10,298,128
Chandler-Evans Corp., South Meriden, Conn.	War	Assemblies	101,250
Standard Machinery Co., Providence, R. I.	War	Bearings	141,120
Sheffield Gage Corp., Dayton, Ohio	War	Machine tools	125,000
Berg Warner Corp., Rockford Drilling Machine Co. Div., Rockford, Ill.	War	Flywheel assemblies	165,474
Republic Steel Corp., Cleveland, Ohio	War	Small arms material	140,149
Consolidated Machine Tool Corp., Rochester, N. Y.	Navy	Boring mills	184,704
Bristol Yacht Building Co., So. Bristol, Me.	Navy	Minesweepers	300,000
Federal Motor Co., Detroit, Mich.	War	Tractor-trucks	908,428
International Harvester Co., Chicago, Ill.	War	Trucks	668,546
Consolidated Steel Corp., Ltd., Maywood, Calif.	War	Structural steel	146,098
Bethlehem Steel Co., Pittsburgh, Pa.	War	" "	124,350
National Cash Register Co., Dayton, Ohio	War	Fuse shell	769,919
Mullins Mfg. Corp., Warren, Ohio	War	Cartridge cases	5,076,325
Cleveland Welding Co., Cleveland, Ohio	War	Casing burster	484,330
Globe Mach. & Stamping Co., Cleveland, Ohio	War	Cartridge cases	859,250
Trackson Co., Milwaukee, Wis.	War	Gun mounts	100,791
Central Steel Tube Co., Clinton, Iowa	War	Tripod mounts	302,315
Evans Products Co., Detroit, Mich.	War	" "	1,278,440
James Cunningham Sons & Co., Rochester, N. Y.	War	Carriage assys.	1,993,620
Lamson Co., Syracuse, N. Y.	War	Mounts	441,000
McEvoy Company, Houston, Texas	War	"	759,780
Jackes-Evans Mfg. Co., St. Louis, Mo.	War	Belt links	783,000
B. F. Goodrich Co., Akron, Ohio	War	Band tracks	7,189,539
Firestone Tire & Rubber Co., Akron, Ohio	War	Belt links	5,986,340
J. Cunningham Sons, Rochester, N. Y.	War	Carriage assys.	294,600
J. G. Brill Co., Philadelphia, Pa.	War	Pack howitzer	189,627
Universal Crusher Co., Cedar Rapids, Iowa	War	Cradle assys.	802,410
Capital Steel & Iron Co., Oklahoma City, Okla.	War	Structural steel	154,585
Oliver Iron & Steel Corp., Pittsburgh, Pa.	War	Fuse plugs	118,125
Barnard Aviation Equip. Co., Ashley, Pa.	War	Belt links	928,550
Pettibone Mulliken Corp., Chicago, Ill.	War	Carriage parts	3,817,884
Crown Cork & Seal Co., Inc., Baltimore, Md.	War	Gun mounts	1,147,030
Carter Carburetor Corp., St. Louis, Mo.	War	Fuse parts	1,331,715
Fulton-Sylphon Co., Knoxville, Tenn.	War	"	207,772
International Harvester Co., Chicago, Ill.	War	Tractors	523,581
Continental Motors Corp., Muskegon, Mich.	War	Engine parts	740,747
American Type Foundries, Elizabeth, N. J.	War	Recoil mech.	570,380
General Elec. Co., Schenectady, N. Y.	War	Locomotive	398,700
Thomas B. Gibbs & Co., Kelavin, Wis.	War	Regulating equip.	354,832
Rockford Drilling Mach. Div. of Borg Warner Corp., Rockford, Ill.	War	Fan and hub assys.	165,474
D. W. Onan & Sons, Minneapolis, Minn.	War	Generator set	237,700
Basalt Rock Company, Inc., Napa, Calif.	Navy	Barges	1,800,000
Dravo Corp., Pittsburgh, Pa.	Navy	Sub. chasers	3,447,000
Consolidated Shipbuilding Corp., New York, N. Y.	Navy	"	2,825,000
Grumman Aircraft Engineering Corp., Long Island, N. Y.	War	Airplanes	250,070
Studebaker Corp., South Bend, Ind.	War	Engines	33,657,580
Autocar Company, Ardmore, Pa.	War	Half track carriers	17,873,649
Ford Motor Co., Alexandria, Va.	War	Bomb trucks	171,430

CONTRACTS FOR NEW PLANTS

WASHINGTON—Curtiss Propeller Div., Curtiss Wright Corp., has been awarded a $5,221,100 contract by U. S. Defense Plant Corp. for the construction of an airplane propeller plant at Beaver, Pa., near the Pittsburgh industrial area. American Brass Co., Waterbury, Conn., has been awarded a $4,750,000 contract for the construction of a new plant at Kenosha, Wis. The company will manufacture ammunition brass and ammunition cups. Bridgeport Brass Co., Bridgeport, Conn., has been awarded $11,500,000 for construction of a plant to manufacture cartridge cases at Indianapolis, Ind. Aeronautical Products Corp., Detroit, will make a $495,880 addition to its present plant; Briggs Manufacturing Co., Detroit, will make a $288,100 addition to its plant for the manufacture of wing assemblies for Douglas. Aeronautical Products Corp. is manufacturing parts for landing gears, engines, and carburetors.

Procurement Questions Answered at Forum

NEW YORK—Following the familiar "Information Please" technique, a meeting of the New York Post, Army Ordnance Association, was held February 24 in the auditorium of the Engineering Societies Building to clear up questions on ordnance procurement. Proceedings were opened by Brig. Gen. Samuel McRoberts, who heads the New York Post. James R. White, chairman of the committee on arrangements, posed the questions to the experts.

The program consisted of two parts. The first included questions submitted in writing prior to the meeting; the second used questions that were gathered by the ushers on slips of paper during the proceedings. Topics dealt with methods of securing national defense business, types of contracts, labor provisions, including such questions as the employment of aliens and the application of the Walsh-Healy Act, methods of financing government orders, including permissible methods of amortizing new equipment, and methods of government aid in procuring additional plant facilities.

The board of experts consisted of the following: Ralph E. Flanders, group administrator, Machine Tool Equipment and Small Tool Priority Committee, Office Production Management, R. E. Gilmore, president, Sperry Gyroscope Corporation, and the following representatives of the New York Ordnance District: Col. J. K. Clement, executive officer, Maj. F. R. Mead, chief artillery division, Maj. E. I. Ross, chief ammunition division, Maj. C. Mueller, chief executive division and Mr. George H. Foisy, chief fire control division.

Aircraft Section Head

TOM TOWLE

Machinery Manager

PAUL W. ARNOLD

Resigns at Bullard

THOMAS E. DUNN

NAMES in the NEWS

Addison C. Armstrong has joined Worthington Pump and Machinery Corp., Holyoke, Mass., as manager of the Ordnance Div.

Paul W. Arnold has been named manager, machinery design applications, Reliance Electric & Engineering Co., Cleveland.

David J. Byrnes, who recently resigned as sales manager, Hein-Werner Motor Parts Corp., Waukesha, Wis., has been elected president and general manager, Union Equipment Corp., Milwaukee.

Carl W. Coslow, formerly mechanical superintendent, Hamilton Watch Co., Lancaster, Pa., will join the executive staff of the Lockheed Aircraft Corp., Burbank, Calif.

Robert L. deLoche has been appointed manager, Philadelphia switchboard plant, Westinghouse Electric.

Thomas E. Dunn has resigned as director and works manager, Bullard Co., Bridgeport, Conn. He will be succeeded by Foster P. Whitworth. Mr. Dunn joined the Bullard Co. in 1917 as night superintendent of the engineering works. Later he was named assistant production manager, and in 1921 was advanced to the office of production manager. He became assistant works manager in 1922 and a few years later assumed full responsibility as the company's works manager. In 1930 Mr. Dunn was elected a director.

Dr. Jesse E. Hobson has received the Eta Kappa Nu award as the country's outstanding young electrical engineer for 1940. He is a member of the engineering staff, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Ernest C. Low has been appointed general manager of sales, John A. Roebling's Sons Co., Trenton, N. J.

Louis F. Malkovsky has been elected vice president, Sperry Gyroscope Co., Long Island City, N. Y. He joined

WILLIAM L. DOLLE

T. I. PHILLIPS

Their appointments as president and general manager, Lodge & Shipley Machine Tool Co., and as assistant to the president, Westinghouse Electric & Mfg. Co., respectively, were announced in these columns

Sperry in 1914 as a toolmaker, and in 1938 was named factory manager. In his new position, he will be in charge of production on the entire line of products of Sperry Gyroscope.

James M. Mead has been named manager, Philadelphia plant, Ryerson Steel Co., Chicago. Mr. Mead succeeds Arthur C. Allshul who retired recently after 42 years of service with the company.

Verne E. Minich who founded the American Foundry Equipment Co., Mishawaka, Ind., has been named chairman of the board; until recently he was its president. Otto A. Pfaff, formerly vice president and general manager, has been named president and remains general manager. Leslie L. Andrus, formerly sales manager, has been named vice president in charge of sales.

Ralph R. Newquist has been appointed manager, Houston district office, Allis-Chalmers Mfg. Co., Milwaukee.

K. P. Rolston, formerly chief engineer, Screw Machine Co., Pittsburgh, has been named works manager, Hunter Manufacturing Corp., Bristol, Pa.

William H. Seaman, formerly vice president, Mesta Machine Co., Homestead, Pa., has been named president and general manager, National Roll & Foundry Co., Avonmore, Pa. He succeeds D. H. Slonaker who has been named chairman of the board.

Dr. William G. Theisinger has been appointed director, welding research, Lukens Steel Co., Coatesville, Pa.

Tom Towle has been named head, Aeronautical Engineering Section, Aircraft Division, Hudson Motor Car Co., Detroit. For the past 20 years he has been identified with major producers in the aircraft industry.

PLANT EXPANSION

The American Rolling Mill Co., Middletown, Ohio, will build a new steel plant on the ship canal near Houston, Texas. A new Texas corporation, a wholly-owned Armco subsidiary, will be organized to build the plant. An RFC loan of $12,000,000 has been authorized for the new company. Operations of the new plant will be managed by the Sheffield Steel Corp., another Armco subsidiary which operates plants in Kansas City and St. Louis.

A new $5,000,000 black furnace with a daily capacity of 1,000 tons of pig iron will be constructed at the Ashland, Ky., plant of Armco. The new furnace, which will be one of the largest in the industry, is expected to be completed within one year.

Served 50 Years

GEORGE KLENK

Norton V-P Dies

LEWIS E. SAUNDERS

The DeVilbiss Co., Toledo, has leased 50,000 sq. ft. of space in the nearby former Bock Bearing plant to manufacture air compressor units for the U. S. Army.

General Electric X-Ray Corp., Chicago, is building an 18,000 sq.ft. addition to cost about $450,000 complete with equipment.

Ryan Aeronautical Co., San Diego, Calif., will construct a new aircraft plant at a cost of $350,000. The expansion will increase the company's floor space to 240,000 sq. ft.

The largest plant in the world devoted exclusively to the manufacture of fluorescent lamps, will be built by Westinghouse Electric Co., at Fairmont, W. Va., at a cost of $3,000,000.

BUSINESS ITEMS

Adelphi Mfg. Co. has moved to new offices at 571 Carroll St., Brooklyn, N. Y.

The Black-Clawson Co., Hamilton, Ohio, has purchased the buildings and plants of the Dilts Machine Works, Fulton, N. Y.

North West Steel Co., Ltd., was recently incorporated at Victoria, B. C., with 100 shares of stock without nominal or par value.

OBITUARIES

Fred W. Behling, 68, president, Kagel Brass Foundry Co., Milwaukee, died at his home recently.

Fred R. Donaldson, 64, vice president and one of the founders, Machined Steel Castings Co., Alliance, Ohio, died recently.

George Klenk, for many years brass foundry superintendent, Allis-Chalmers Mfg. Co., Milwaukee, died recently of a heart attack. He had been connected with the company and its predecessors for more than 50 years.

Guernsey A. Palmer, 55, district manager, Baldwin Southwark Div., Baldwin Locomotive Works, Houston, Tex., died recently.

Lewis E. Saunders, 67, vice president Norton Co., Worcester, Mass., died recently after a short illness. He had been vice president since 1937 and a director since 1921. He was also a former manager of the company's abrasive plant and research laboratories.

William Thomas, sales manager and assistant chief engineer, Waterbury Tool Div., Vickers, Inc., Waterbury, Conn., died recently.

MEETINGS

American Gear Manufacturers Association. Annual convention. Hot Springs, Va., the Homestead, May 5–7.

American Society of Mechanical Engineers. Army and Navy meeting on national defense. Hotel Statler, Cleveland, Ohio. March 12–13, 1941.

American Society of Mechanical Engineers. Spring meeting. Atlanta, Ga., April 1–3.

American Society of Tool Engineers. Annual meeting. Detroit, Mich., March 24–29.

Machine and Tool Progress Exhibition. Sponsored by the American Society of Tool Engineers. Convention Hall, Detroit, Mich., March 25–29.

Society of Automotive Engineers. National Aeronautic meeting. Washington Hotel, Washington, D. C., March 12–14.

SHOP EQUIPMENT NEWS

N.M.T.B.A. Automatic Shell Machines In Production to Accelerate Defense

The machine tool industry, working through the Defense Committee of the National Machine Tool Builders' Association, some months ago designed a line of special machines for making shell. Purpose of the project, undertaken at the suggestion of Army Ordnance officers, was to put into the hands of the War Department complete and tested designs for shell machines that could be built quickly in any well equipped manufacturing shop whenever the need for them arose. These machines are now in production.

By making it possible for plants not otherwise engaged in the defense program—such as those manufacturing printing presses and textile machinery—to build shell machines, the machine tool industry has broadened the source of supply and at the same time freed itself to a greater extent to concentrate on production of equipment for aircraft engines, tanks, guns and other items that require precision machine tools. Though shell manufacture is important, it is not a precision job. The closest limit on a shell is 0.005 in., and most limits are from 0.020 to 0.030 in.

Only Two Sizes

The design comprises a complete line of machines for turning, boring and facing medium-caliber shell. Machines are of two sizes—one for the 3-in. group of shell, the other for the 6-in. group. In each group is a basic machine that is standard for all operations in that group. Each unit is then equipped with whatever slides, tailstock, tooling equipment and motor drive are required for a certain operation. The machines are capable of all operations except cross drilling, notching, and such operations as nosing-in, squeezing the band into the band seat, and welding the base end-plate. Engineering work was done under direct supervision of Myron S. Curtis, consulting engineer in machine design.

There are three outstanding features about the new machines. They are (1) of simple construction so they can be built quickly in substantial quantities; (2) inexpensive and can produce shell economically; and (3) automatic so they can be handled by unskilled operators.

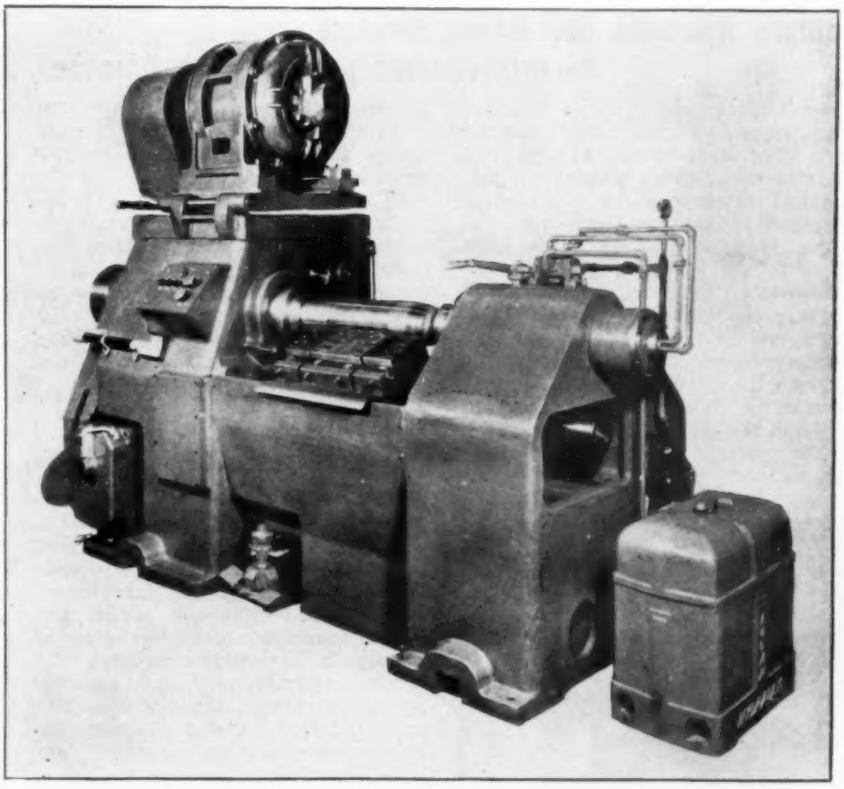
To make construction as simple as possible, the design completely eliminates all large planing and boring operations and all machining operations, large and small, on the main casting, except for drilling of a few small holes. This is accomplished by supporting the carriage for the turning tools as well as the swinging arms for facing operations entirely on longitudinal bars instead of planed way surfaces. Moreover, these bars (there are three of them) together with the spindle, tailstock sleeve and all shafts, are carried by bushings which are cast in place in the main base of the machine.

The casting-in-place of bushings is accomplished by use of a pouring fixture for locating and supporting the bushings on pilot bars, and the use of a low melting point lock-in metal. The base of the machine has pouring holes cast in it, and in some cases two bushings are poured through the same hole. The recommended pouring metal is a lead-tin, high-bismuth alloy which expands slightly upon cooling.

In addition to the bushings supporting all shafts, the seat upon which the cover plate rests is also made of this alloy. Metal is poured in a trough on top of the headstock and allowed to find its own level. The cover plate, which also supports the motor, is then fastened to the base casting upon this seat. All doors and plates are attached to the rough base casting by cap screws. Neoprene gaskets used with doors and plates insure oil-tight joints, as door seats are not machined.

No Speed-Changing Mechanism

Machines are all single-speed units, except in cases where two-speed motors are used. Motors vary from 10 to 60 hp., depending on the operation to be performed. Main drive of the machine is through V-belts to a drive shaft and through a jackshaft to the spindle. Drive to the feed mechanism is through a chain and sprockets to a set of pickoff gears, then through a shaft to a feed worm and gear. This gear drives a drum cam for reciprocating a sliding bar on which the turning carriage is located, as well as face cams for operating the facing arm and



Streamlining and tricky gadgets have no place in this National Machine Tool Builders' Association shell lathe. A man-sized machine built to do a man-sized job, it is stripped down to bare essentials for easy manufacture in any well equipped shop. This lathe for 6-in. shell is typical

the bar for supporting and oscillating the turning carriage.

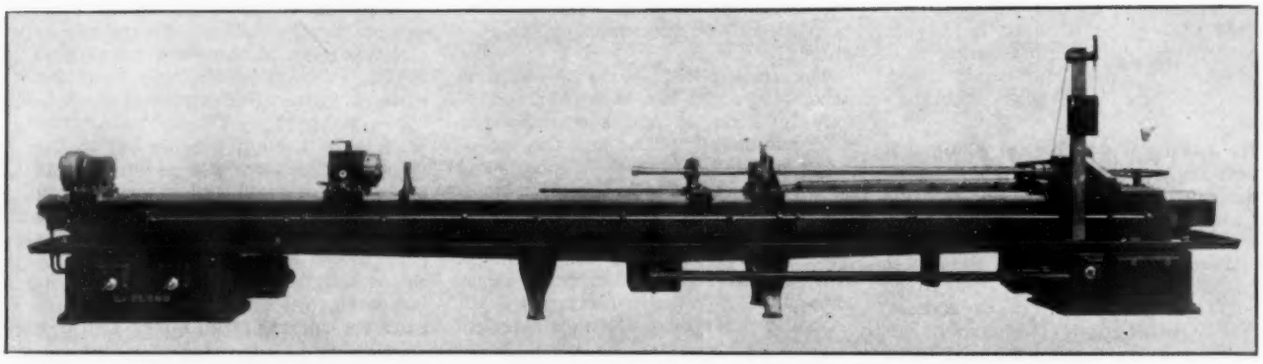
A constant-speed, individual motor is belted to the feed box for rapid traverse of the tool carriage. Certain of the tool blocks are slideable in the tool carriage. These are controlled by a stationary cam bar. The spindle and all shafts run in plain bearings. These bearings are bronze, with a lining of babbitt about 0.080 in. thick. There is a ball thrust bearing on the spindle as well as on the feed drum shaft.

The machine has a live tailstock center which is moved longitudinally by hydraulic pressure. The valve for controlling this hydraulic movement is operated by the binder lever. Only one movement of the lever is necessary to move the center into position and to clamp it. Likewise, reverse movement of this lever both unclamps the tailstock and removes it from the work.

There are two principal methods of holding the shell: (1) gripping it on the inside of the open end by an expanding arbor, while using the tailstock center for supporting the base end of the shell; and (2) gripping it on the outside diameter by a collet chuck. In either case the shell-holding mechanism is hydraulically actuated, and control is by means of pedals, in order to leave the operator's hands free. It is intended that one central hydraulic system, with accumulator and tank, will serve a complete line of machines, to avoid the greater expense of a self-contained hydraulic system for each.

Lubrication of the machine is by gravity from a trough cast in the top of the base and from which oil pipes lead to the various bearing surfaces. Oil settles in a sump in the base of the headstock, from which it is pumped by a separate motor-driven unit through a strainer and pressure valve back to the oil trough. The pressure switch consists of an electrical unit so connected with the control system that none of the operating motors, with the exception of the lubricating pump motor, can be started or operated unless there is sufficient pressure on the lubricating system.

It is intended that coolant be supplied a line of machines by gravity from a central tank, the coolant from the machines being pumped back to the tank from a collecting sump. The central system would reduce costs and keep the coolant at a much lower temperature than possible otherwise.

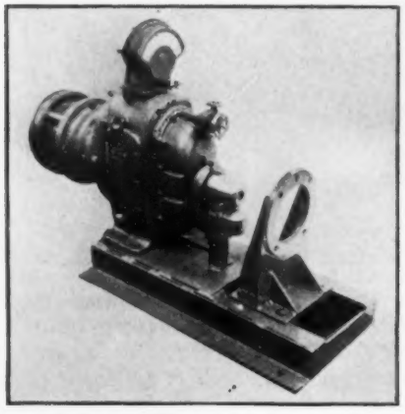


LeBlond Hydraulic Gun Rifling Machine Permits Grooves to Be Cut or Broached

Grooves can be either cut or broached with the No. 2 gun rifling machine built by R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. Simplicity of mechanical features is an outstanding characteristic of this hydraulic machine, which is built to handle guns up to 3 in. bore, 88 in. in length.

Adjustable automatic stops control carriage movement. Conveniently located on the control rods are two manually operated levers. The control rod runs the full length of the bed, and operates a four-way valve to start, stop and reverse the direction of travel of the carriage. In the head-end leg are two adjustable hydraulic speed control valves—one to change the speed of the carriage on the forward stroke, and the other to change the speed on the return stroke.

A 5-hp. constant-speed motor is directly connected to a constant delivery, vane type rotary pump, feeding the main hydraulic cylinder. Rotation of the cutter bar is provided either by the former or profile ribbon of the rifling bench, or by a groove machined in the cutter bar itself.



Link-Belt Test Rig Gives Infinitely Variable Speed

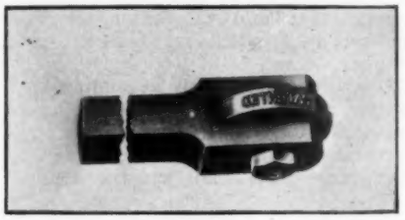
Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill., has developed the P.I.V. gear positive infinitely variable speed test rig especially for production testing of generators, magnetos, governors, vibrators, pumps, springs, sewing machines, bearings and similar types of equipment. Comprising a compact, fully inclosed variable-speed unit and adjustable mounting bracket assembled on a rigid welded steel base, this device accommodates a wide variety of sizes, types and speeds of equipment.

The mechanism to be tested is placed in position on the horizontally adjustable mounting bracket, moved up as required, and then connected to the variable speed output shaft of the transmission. An electric tachometer and calibrated speed indicator positively driven from the variable-speed shaft provide means for observing exact speed at which the mechanism is being tested. A direct handwheel control and a second vernier control permit extremely precise speed selection.

AcromarK Roller Die Made for Use in Lathes

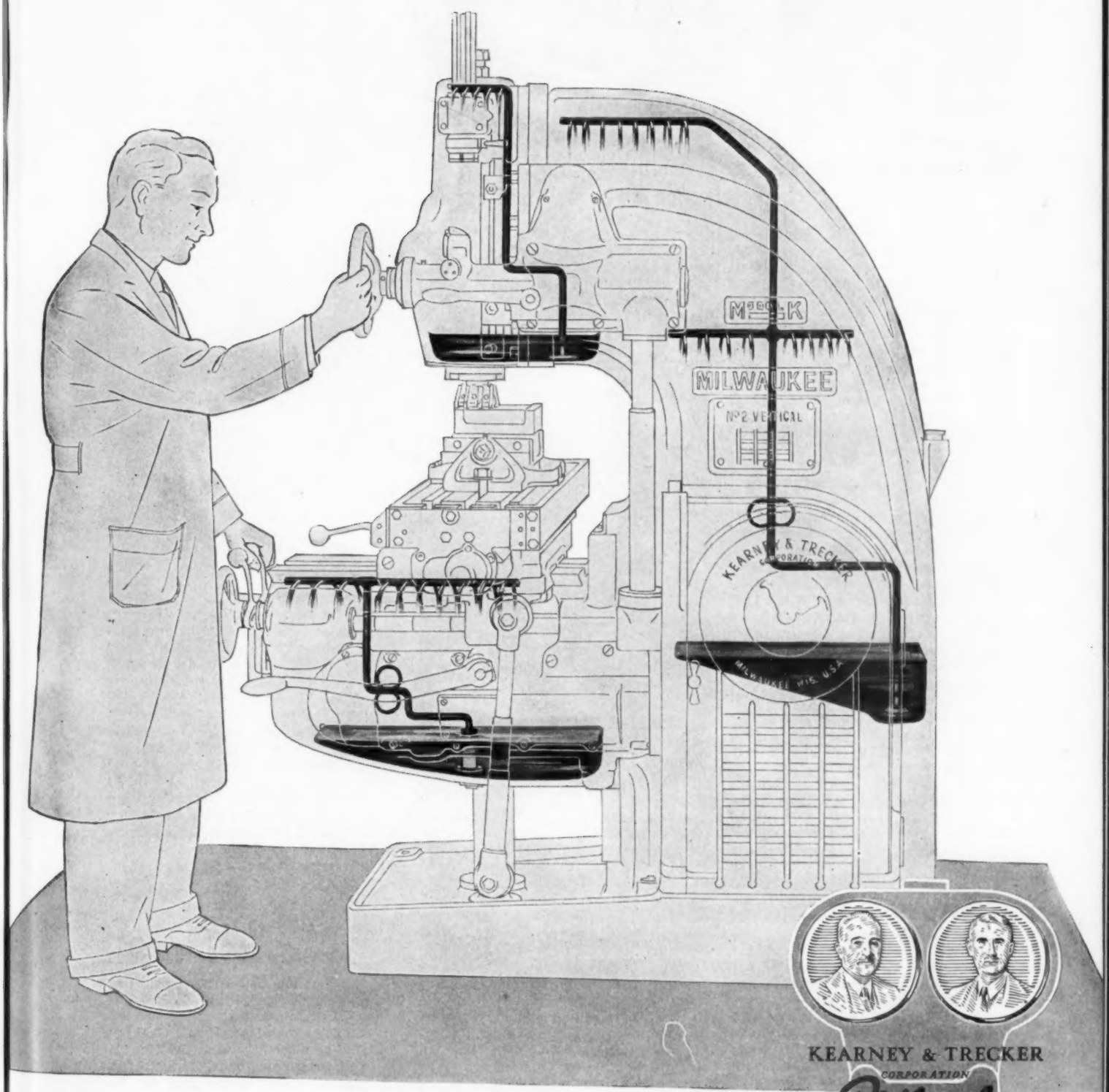
Parts turned in lathes can be quickly marked with this roller die and holder offered by H. O. Bates (AcromarK Corp.), 245 N. Broad St., Elizabeth, N. J. The steel roller die can be engraved with any numbering, lettering or design. In use it is a simple matter to rotate the lathe by hand, rolling in a perfect marking.

The roll can also be made to receive segment style interchangeable steel type where interchangeable lettering or numbering is desired. For continuous marking where the part must completely rotate—as in applying graduations to a ring—then a fixture is furnished so that the part and the die can be synchronized by gears.



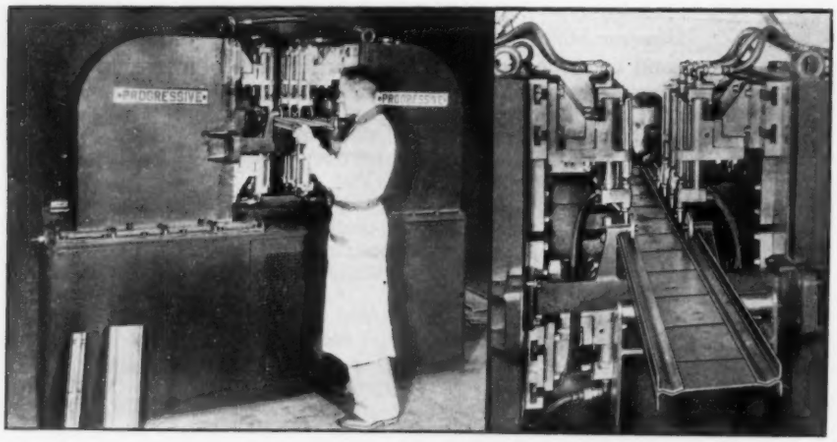
Lubrication—vital to the life of any machine—is provided in the Milwaukee Milling Machine by automatic pressure pumps in the column and knee, and in the sliding head on vertical machines. Automatic pump lubrication of this type requires only a minimum of attention.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.



KEARNEY & TRECKER
CORPORATION
Milwaukee
MILLING MACHINES

MILWAUKEE MILLING MACHINES



Progressive Welder Features Flexibility In Fabrication of Sheet Steel Shapes

Capable of a production of 1200 lineal ft. of "Stran-Steel" members per hour, a multiple-spot welding machine developed by Progressive Welder Co., 3001 E. Outer Drive, Detroit, Mich., is designed for extreme flexibility in handling numerous combinations of sizes and shapes of sheet steel.

Previously riveted and later spot welded by means of a single-spot machine, the entire line of "Stran-Steel" joists, studs, half studs, and narrow studs of light gage copper bearing steel is first formed into angles or channels and then so joined as to provide a nailing space along the entire length of each member. The projection formed by bubbles stamped at regular intervals along one half of the completed section provides this nailing space.

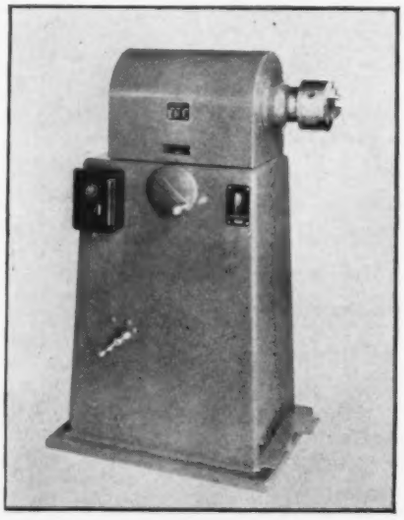
Two identical machines, each employing twelve vertically opposed sliding contact guns and six welding transformers (one for each spot weld), are used. An air-hydraulic booster with a large reservoir and high pressure capacity supplies pressure for simultaneous operation of the guns.

To accommodate various widths, provision is made for adjustment as to distance between guns on each side. Guns may be moved also for proper spacing between spots longitudinally. This, together with the provision for cutting out the guns on either side (permitting the machine to be used for welding half-stud members) makes each machine capable of welding any "Stran-Steel" section.

Since varying gages of metal (joists, for instance, are made up in 11, 12, 13, 14 and 16 gages) require different welding pressure, time and current, provision for adjustment of each is made.

Indicative of the versatility of the machines is the wide range of sizes handled. Web widths of members vary from about 2½ and 3½ in. per narrow stud and standard stud respectively to 9 in. for the joist. Half studs, made up of two angle sections and welded with one set of guns only, are about 2 in. over-all in web width. Flange widths for all are 2 in.

One set of small rolls mounted inside the two rows of guns supports the work midway between the upper and lower welding points. These rolls also locate the position of the spot welds which are made through each bubble in the member. Another set of rolls positions the work laterally.



Schauer Low-Speed Lathe Built for Precise Lapping

Accurate lapping of gages and other small parts at speeds as low as 20 r.p.m. is possible with the Type VA3B variable speed lathe built by Schauer Machine Co., 2063 Reading Rd., Cincinnati, Ohio. Capable also of rotating heavy work at speeds up to 4,000 r.p.m., this machine is well adapted to perform final finishing operations such as filing, burring and polishing.

Between these two limits, speeds are infinitely variable. Optional is an adjustable slippage arrangement between motor and spindle, permitting the application of only a predetermined amount of pressure on the part to be lapped. The machine is equipped with a standard NEMA frame motor, quick-acting automatic brake, 3 or 4-jaw chuck, or special work holding fixture.

T.C.M. Carbide Tool Grinder Sharpens Many Common Types

Nearly all common types and forms of carbide tools can be sharpened with the "All-in-One" grinding and lapping equipment developed by T.C.M. Mfg. Co., Harrison, N. J. Available in bench and floor models, there are five types of head assemblies with alternative wheel and lap equipment.

Complete accessory equipment is available, by means of which special operations other than grinding and

lapping can be conveniently carried out. Included in this equipment are a groove grinding device for forming chip control grooves in cemented carbide tips, a protractor with micrometric feed for accurate duplication of tool profiles, a tip cutting attachment for resizing and salvaging carbide tips, and a drill grinding attachment which has a capacity from ¼ to 1¼ in. diameter twist drills.

Motor with pre-loaded ball bearings operates at 1750 r.p.m. Right and left-hand tools are ground with equal facility by having a 10-deg. convex angle on the face of the grinding wheels and diamond metal laps, which provides the equivalent of a large diameter wheel used peripherally. The slight concavity thus formed on the ground face facilities lapping of the small lands on the cutting edges of carbide tips, while the extra expense and complication of a reversing motor is avoided. A specially designed brazing fixture is available for those who wish to braze their own tips on the tool shanks.

"Landmaco" Shell Tapper Accommodates Smaller Sizes

Landis Machine Co., Waynesboro, Pa., has developed the Type HO "Landmaco" shell tapper for cutting threads on smaller sizes of shell which cannot be handled efficiently with the No. 1½ R shell tapper previously announced. This small shell tapper has for its basic design the "Landmaco" threading machine, with a collapsible tap substituted for the usual die head and

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Removing 18 lbs. of Nitrided Steel . . . *in 7 Minutes!*

That's the way SUNICUT is helping speed up production throughout the defense industries.

This large manufacturer is "finning" air-cooled airplane engine cylinders with parallel fins at the rate of 7 cylinders per hour and maintaining unusual accuracy—thanks to a copious flow of SUNICUT, the straight cutting oil for high speed production. This clear free-flowing sulphurized mineral oil possesses excellent heat conducting and metal wetting properties. . . . Makes practical heavy cuts at high speeds with fine finish. Sunicut's unusual transparency makes possible extreme accuracy because it permits micrometer readings and easy observation of the tools and finish at all times.

If you're interested in speeding up your production and maintaining accuracy let us send you more information about SUNICUT and our new folder "Straight Facts About Straight Cutting Oils"—just write . . .

PERFORMANCE DATA

OPERATION—Finning Air Cooled Airplane Engine Cylinder.
MACHINE—Jones & Lamson Heavy Duty 16" Fay Automatic Lathe.
MATERIAL—Nitrided Steel.
TOOLS—47 H.S.S. tools in a single bank, removing 18 lbs. of metal in 7 minutes cutting time.
CUTTING LUBRICANT—Sunicut.

Photo Courtesy of
JONES & LAMSON MACHINE CO.

SUN OIL COMPANY, PHILADELPHIA, PA.

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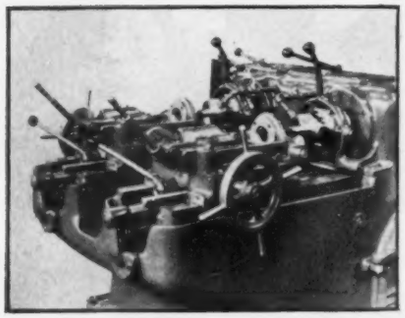
SUN OILS

PETROLEUM PRODUCTS FOR ALL INDUSTRIES



a special work-holding device to support rigidly the shell parts.

The tap is designed primarily for cutting straight threads. It is made of alloy steel and all parts are hardened or heat-treated and precision ground. Means in the tap tripring direct coolant within the bore of the work. The special work holding device is mounted directly on the carriage. It comprises a hardened and ground bushing to support the nose end of the shell and either a male or female rear centering bushing, depending upon the type of part to be threaded, which not only supports the base end of the shell but also provides clamping action for rigidly supporting the work in the fixture. The rear centering bushing is mounted on a slide in direct contact with a lever-operated cam to advance the bushing which provides the means for locking the work in the fixture. A pressure spring returns the bushing, releasing the work when the operator releases the cam. This unit is adjustable for work of different lengths within the range of 60-mm. and 81-mm. mortar shells of the high explosive type and is also suitable for the 3-in. British mortar type shell.

The "Landmaco" HO shell tapper is of the leadscrew type to assure accurate thread lead. It is made primarily in the double spindle model since an operator can efficiently operate both die heads and practically double the production which would be obtained with a single head machine.

"Airlox" Pneumatic Vise Fits Machines and Benches

The grip of a screw vise is combined with the quick action of air in the "Airlox" pneumatic machine and bench vise offered by Production Devices, Inc., 213 Comstock Bldg., East Hartford, Conn. Spring jig and special jaws used with foot, hand, cam, air or electrically operated valves speed milling, shaping, planing, drilling, tapping, assembling and bench work with this device.

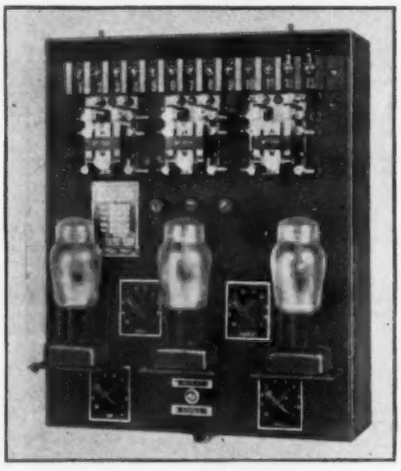
Vise utilizes a spring-acting air piston and cam to furnish greater power to the jaw. This jaw is instantly adjustable and self truing. Facings are hardened and ground for long wear. Castings are of Meehanite for greater strength and uniformity.

Specifications: Length over-all, 20 in.; width over-all, 7 in.; height over-all, 4⅛ in.; jaw width, 5 in.; jaw depth, 2¼ in.; jaw travel, ⅝ in.; maximum jaw opening, 5 in.; weight, 55 lb.

Weltronic Welding Timer Eliminates Pressure Switches

To eliminate air or hydraulic pressure switches in resistance welding and to provide accurate timing control for any air-operated spot welder, the Model 75 electronic tube timer has been added to the line of timers and controllers manufactured by Weltronic Corp., 3051 E. Outer Drive, Detroit, Mich. Featuring a minimum of moving parts as well as eliminating the need of a pressure switch, this timer insures minimum maintenance costs.

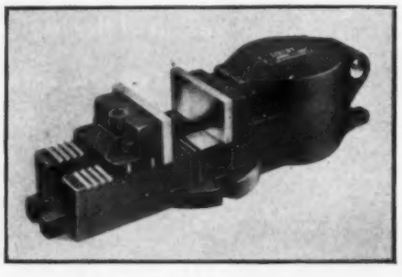
Using a repeating timer to eliminate a pressure switch requires one additional timing function. The four adjustments required are: squeeze time, weld time, hold time, and off time. Squeeze time is the interval between the instant the initial welding pressure is applied and the welding current is on, which allows sufficient time to permit full welding pressure to build up before welding current is applied. Thus



the timer compensates for effects of lowered room temperatures or extreme distance from pressure switch to welder and insures uniform performance and better quality welds.

The four adjustments are made by dialing the control knobs on the front of the panel. The wide range of optional time selection from 2 to 30 cycles in close steps provides accurate timing for almost any stationary or portable, single or multiple spot welding operation where air or hydraulic pressure is used. Single weld or automatic repeat operation is optional to suit the work.

Timer is available for use with either a magnetic or Ignitron tube contactor and is standard for 110 volt 60 cycle operation.



Rogers Knife Grinder Takes Heavy Cuts Accurately

Greatly increased production and marked savings in grinding costs are claimed to result from generous size and sturdy construction of the Type NT super duty knife grinder built by Samuel C. Rogers & Co., 191 Dutton Ave., Buffalo, N. Y. This grinder is claimed to be capable of heavy cuts, while at the same time maintaining close limits of accuracy and providing a fine finish under continuous high production.

Machine base is cast as a single unit with ways automatically lubricated by special power driven oil pump. Table is supported on flat and V ways, and is driven at 28 ft. per min. Either hydraulic or mechanical table traverse is available. Cross feeds are either by hand or automatic. Grinding head is mounted on ball bearings and driven by a 5-hp. splash-proof motor. A 14 or 16 in. diameter segmental grinding wheel is used. Four standard sizes are available: 70, 90, 108, and 132 in. Weight of the 90 in. grinder is approximately 4800 lb.

Machine is also built with a special platen for sizing light armor plate, 1 in. thick, 36 in. wide and 100 in. long.

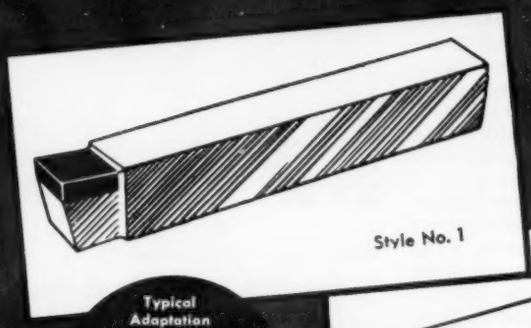
Watermarked Drafting Paper Offered by Lumbric Mfg. Co.

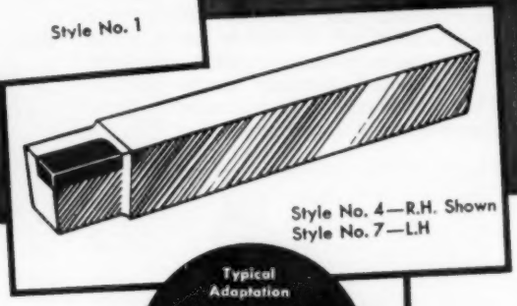
Lumbric Mfg. Co., 19 Park Place, New York, N. Y., has developed a watermarking process that makes it possible to obtain any quantity of any grade of paper used in factory, drawing room and office, with the company's own watermark incorporated into the body of paper. The private watermark reproduces any trade-mark, emblem, industrial design, facsimile, diagram, map, illustration of machinery or products, buildings or an advertising message. Even fine details and miniature lettering can be represented clearly.

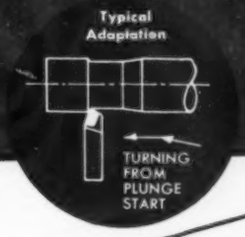
The process is applicable to various factory and maintenance forms, drawing, tracing and detailing papers, records, contracts, certificates, checks, receipts, identification documents and general business stationery. Cost is said to be comparable to that of ordinary stock. Special manufacture does not involve a minimum quantity. Any grade of sulphite or rag content paper, white or colored, can be used.

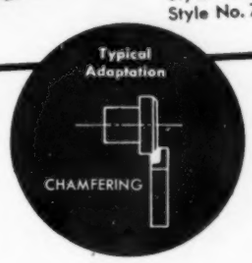
WHY WAIT FOR SPECIAL TOOLS?

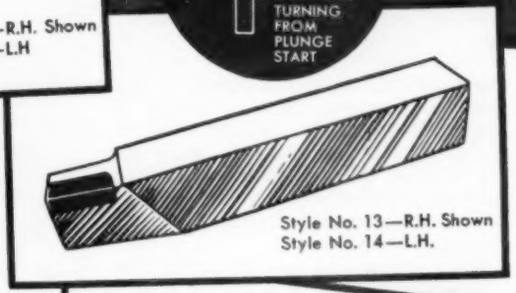
...It's easy to Grind CARBOLOY STANDARD TOOLS to meet many special requirements... and you get them *fast!*











Need carbide tools *FAST*? Machines tied up—or *slowed* up—awaiting tool deliveries?

Carboloy *STANDARD* tools may be the answer...

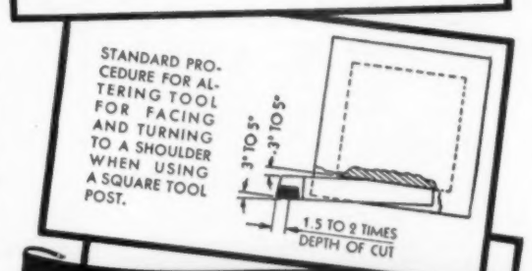
Suitable—in the form you receive them—for 80% of all turning, boring, facing jobs on steel, cast iron, etc., Carboloy *STANDARD* tools can be quickly adapted, when necessary, to meet special requirements such as chamfering, grooving, undercutting, etc. All have LARGE tips to permit variation.

To change Carboloy STANDARD tools for special uses you simply grind—in your tool room—following the same fast, simple grinding methods used for re-grinding Carboloy tools. Many plants now maintain a stock of Carboloy STANDARD tools for quick adaptation to special shapes—as well as for daily use in standard forms.

This is important: If you have not already checked to see how many of your present carbide tool requirements can easily conform with STANDARD tool specifications, do so now. You'll save on initial tool cost—and eliminate needless delays.

Carboloy STANDARD tools are available in five styles and three grades, one for steel cutting, two for cast iron, brass, etc. You get them *FAST*, and at prices close to *steel tools*.

Send for catalog sheets GT-125.


STANDARD PROCEDURE FOR ALTERING TOOL FOR FACING AND TURNING TO A SHOULDER WHEN USING A SQUARE TOOL POST.
3° TO 5°
3° TO 5°
1.5 TO 2 TIMES DEPTH OF CUT

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Order Standard Carboloy Blanks—available for rapid delivery. You mill or grind a recess in your tool shank—and braze in the standard Carboloy blank. Then grind—as easily as you new REGRIND—and the tool is ready for use.

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Carboloy standard blanks are furnished in two styles, 65 sizes, and in grades 78B for steel cutting, 44A & 883 for cast iron, aluminum, brass, etc.

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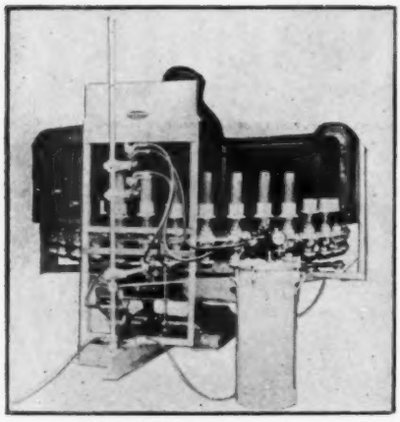
TUNGSTEN CARBIDE—TANTALUM CARBIDE—TITANIUM CARBIDE

VISIT BOOTH 124—MACHINE AND TOOL PROGRESS EXHIBITION—DETROIT—MARCH 25-29, 1941



Eclipse Projectile Painter Sprays 37 to 155 mm. Shell

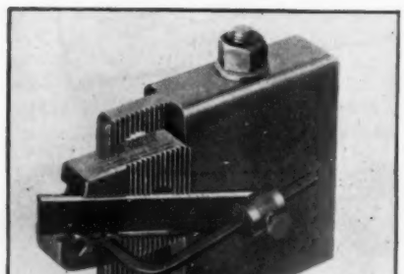
Projectiles from 37 to 155 mm. can be painted automatically with the special machine developed by the Eclipse Air Brush Co., 400 Park Ave., Newark, N. J. This machine consists of a 7-ft. indexed turntable with 36 rotating spindles carrying the shell in front of automatic spray guns which are synchronized with the turntable. After being sprayed, the projectiles are carried through a steam jacketed tunnel type drying oven mounted on the table opposite the spray gun.

Shell are placed on the table and removed manually. Production is approximately 500 per hour when six-minute pyroxylin lacquer is sprayed.

Luers Cutting Off Tool Made for B&S Machines

Empire Tool Co., 8790 Grinnell Ave., Detroit, Mich., has begun manufacture of holders which accommodate the Luers patented cutting-off blade for use on Brown & Sharpe automatic wire feed and hand screw machines, as well as for other automatic and hand screw machines of approximately ⅞-in. capacity and under.

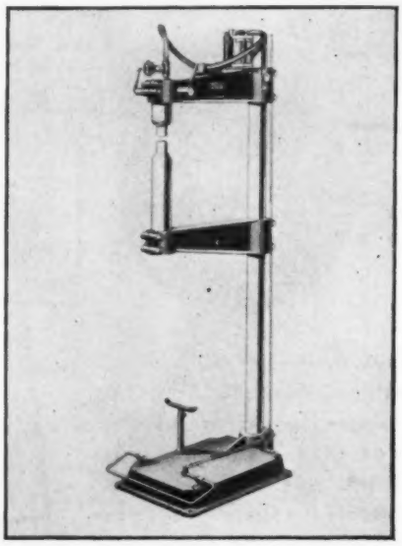
This holder permits blade adjustment for center height with very little of the blade protruding. Thus it is claimed to have all the rigidity of a forged tool. Only one holder is required for operation in either front or back position, with spindle running forward or reverse.

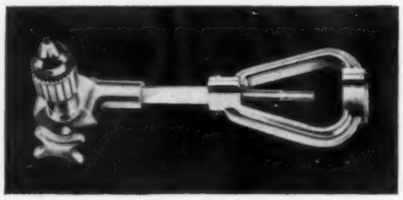


Seiden Planishing Hammer Handles Very Small Radii

Wrinkles formed in drop hammer stamped sheet structures—especially those having very small radii—whether they are made of aluminum, duralumin, stainless steel or other metals, are easily hammered out with the Model SFH 18-12 high-speed planishing hammer developed by Seiden Pneumatic Tool Co., 42 Barrett St., Jackson, Mich. By the installation of proper dies, this machine also makes an efficient riveter for light work, setting solid iron rivets cold up to ¼ in. in diameter.

Hammer has a speed from 4 to 8,000 oscillations per minute, with stroke adjusted from a feather touch to a blow heavy enough to shape and form 18-gage steel. Hammer bracket and die support bracket can be raised or lowered to meet requirements.

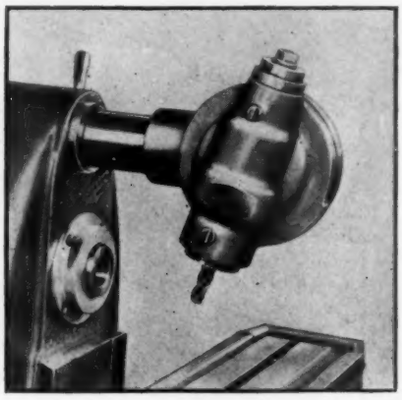




Kett Universal Head Drills at Any Angle

The axis of the drill can be rotated a full 360 deg. in the Model KU-2 universal drill head developed by Kett Appliance Co., Union Central Building, Cincinnati, Ohio. Designed for drilling either wood or steel, this device carries a ⅛-in. Jacob chuck. When used with a ½-in. heavy duty electric drill, it will bore holes in wood up to 2 in. in diameter.

The device can be attached to an electric drill in 3 minutes. It is equipped with bronze bearings and sealed lubrication throughout. Steel gears and pinions are heat-treated for maximum life. Castings are of tough, high-tensile aluminum.



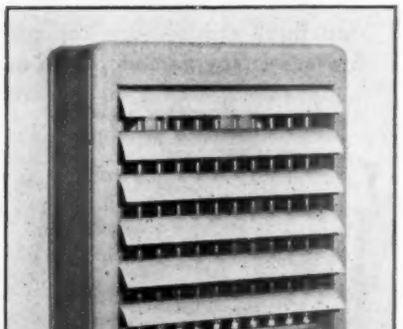
Vernon Vertical Milling Head Increases Versatility of Machine

A vertical head for use with the Vernon No. O horizontal milling machine, developed by Machinery Mfg. Co., 1915 E. 51st St., Vernon, Los Angeles, Calif., can be used freely at any angle and in any plane. Spindle has a No. 7 B&S taper and is driven through compound bevel gears carried in the head, which swivels in a plane parallel to the axis of the shaft. Designed to speed production, this unit is quickly installed by removing the machine overarm. Tools are held by a draw-in collet.

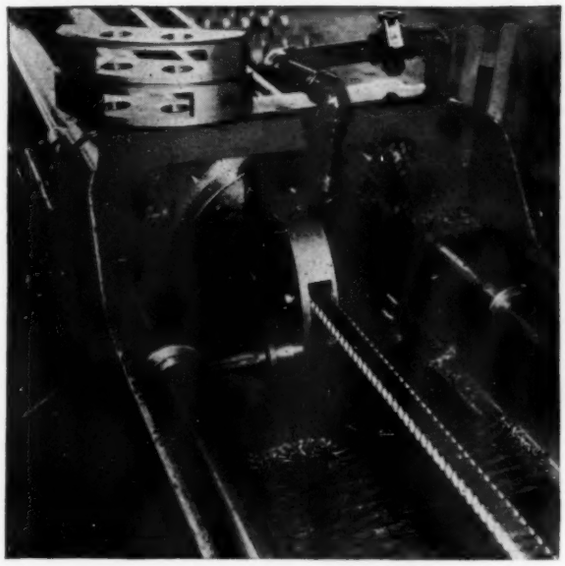
Autovent Steam Unit Heaters Feature Rugged Construction

Extremely rugged construction is an outstanding feature of a completely redesigned line of steam unit heaters announced by Autovent Fan & Blower Co., Chicago, Ill. The streamlined casing has been designed to give added strength and durability for greater protection to the heating element. Each item of the assembly is die-formed, insuring accuracy and stability. Vanes are recessed for appearance and are individually adjustable to direct heat accurately to working areas.

Units employ Series 31 Autovent non-overloading fan wheels. A special screw compression fitting is used between tube and header, thus eliminating welded or brazed joints. Coils are tested at 500 lb. hydrostatic pressure and provide efficient heating at any steam pressure from 2 to 150 lb.



BROACHING PAYS for JOB LOTS IN AIRCRAFT



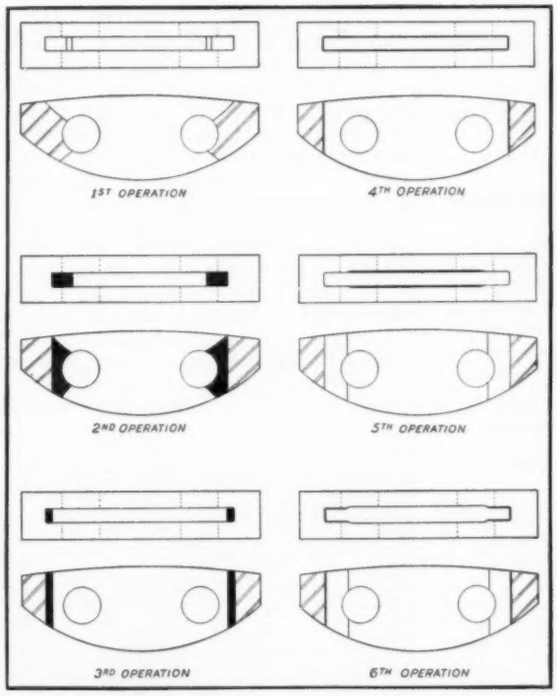
Colonial Universal Horizontal Broaching Machine of 25 tons capacity and 72 inch maximum stroke used for the five slotting operations shown here set up for the second and third operations. (See drawing below). Notice large difference in slot width and length between the unfinished and finished counterweights lying on top of the broaching machine.

The broaching machine again proves its flexibility and application to difficult operations in the shops of a well-known aircraft engine manufacturer. **Here five** operations in slotting the counterbalance weights of a radial type engine are performed on a single horizontal type broaching machine, using but two fixtures and four broaches.

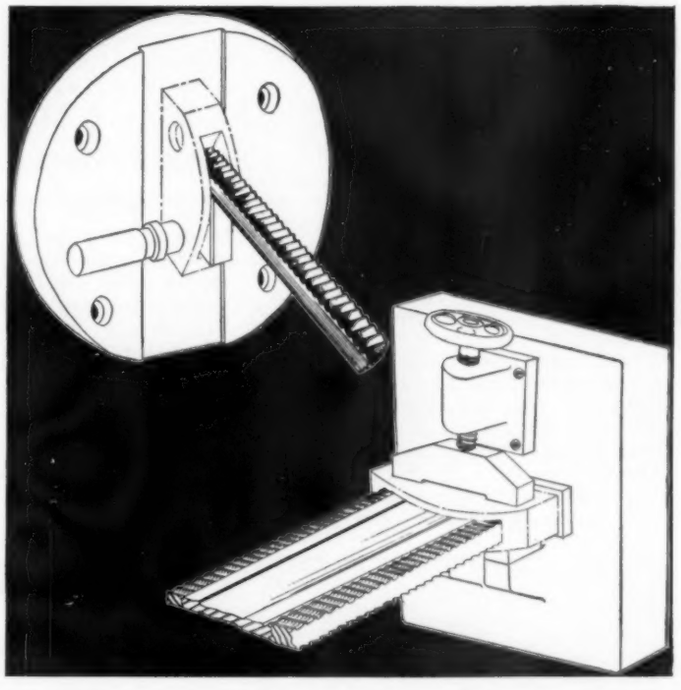
The sequence of operations includes removing excess stock remaining after a preliminary rough milling operation; machining the two ends and sides of the slot in one pass; relieving the center section of the slot, and finally—finishing the total length and width of the slots to accurate dimensions. "Job-lot" quantities are run through each operation before changing broaches, only one change of fixtures being necessary for the entire series of operations.

By using this method of slotting the counterweights, the engine maker has been able to maintain production schedules despite the increased demand for these parts. Proof again that broaching can increase production at low cost.

• • •



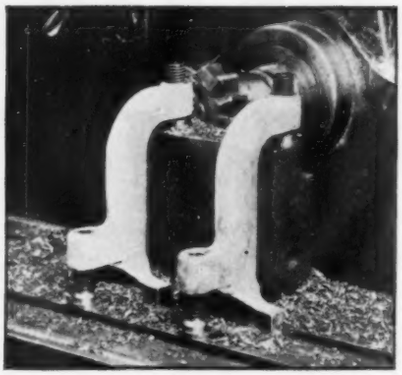
In each operation metal is removed at specified locations to provide the desired final slot form. Heavy lines indicate where metal is removed in each operation.



Only two fixtures are needed for all five broaching operations. The four broaches vary in length from approximately 55 to 15 inches and remove from 0.5 inch to a few thousandths per pass. The fourth, fifth and sixth operations are performed in the same fixture.

COLONIAL BROACH COMPANY

ONE FORTY SEVEN JOSEPH CAMPAU • DETROIT, MICHIGAN



Advance 90-Deg. Angle Clamp Improved for Greater Pressure

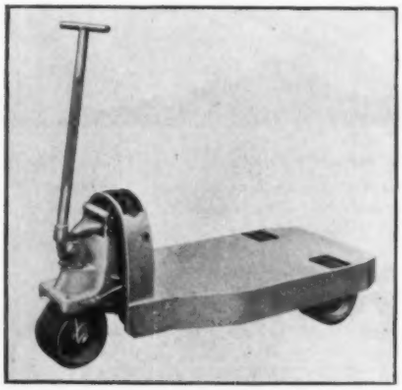
Greater clamping power is provided in the improved 90-deg. angle clamp developed by Advance Machine Works, 3727 Weisser Park Ave., Fort Wayne, Ind. These clamps, for use on T-slotted machine tables, are made of alloy steel having a yield strength of 78,000 lb. per sq.in.

Greater clamping is secured by two clamping contacts. Socket head setscrews are adjusted with a hexagon wrench. Each screw is fitted with a toggle. The lower toggle is made of brass to prevent marring of table from clamping. The device is available in three sizes: 4, 6 and 8 in. throats.

"Load King" Lift Truck Built in Four Capacities

Capacities of 3,500, 5,000, 6,000 and 8,000 lb. are available in the "Load King" hydraulic hand lift truck offered by the Philadelphia Div., Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia, Pa. This truck features easier lift, easier steer, greater operator safety, reduced maintenance and controlled lowering.

Hydraulic lifting unit is self-contained and totally inclosed. The pump is equipped with automotive piston and piston rings for maximum pressure. Hardened and ground automotive type poppet valves, operating on hardened and ground valve seats, insure trouble-free operation. Large ram lowers oil pressure, increases packing life and reduces possibility of leakage. Oil reservoir contains a five-year supply of fluid.



Century Totally Inclosed Motor Changed for Better Performance

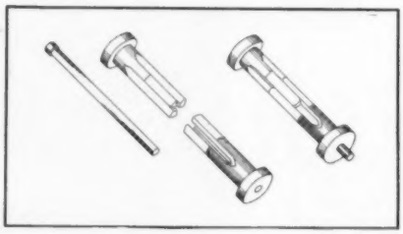
Century Electric Co., 1806 Pine St., St. Louis, Mo., has redesigned its line of totally inclosed fan cooled motors to provide improved appearance and

greater protection. Finished in smooth machine gray, these motors are suitable for use where the air is foggy with metal-cutting solutions or where there are abnormal quantities of metallic abrasive or other dusts in the atmosphere which would injure or clog the windings of a general purpose open motor.

A generous quantity of cooling air is forced through the large air passages by the non-sparking fan, resulting in a cooler motor with cleaner air passages. Air intake passages are not easily clogged, and are designed so that a $\frac{3}{16}$ in. rod will not pass through them.

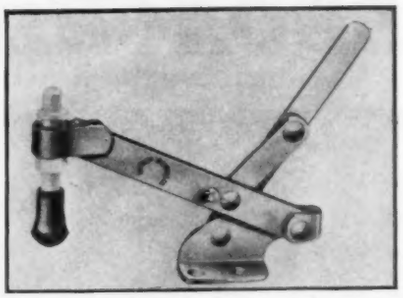
"Durable" Piercing Punch Makes Tiny, Accurate Holes

Holes up to $\frac{3}{16}$ in. in diameter in steel sheet three times as thick as the punch can be made with the "Durable" punch and die developed by Durable Punch & Die Co., 2234-40 Ogden Ave., Chicago, Ill. These punches and dies permit piercing of holes which otherwise would



need to be drilled or reamed. Special telescoping sleeves support the middle of the punch, making possible smaller die clearances and preventing punch breakage.

Holes are claimed to be straight, with no draft or taper. Lapped punches produce a mirror finish in most materials. Punches can be made of carbon, high-speed or high-chrome high-carbon steel, according to requirements.



"De-Sta-Co" Toggle Clamp Suitable for Aircraft Work

Detroit Stamping Co., 343 Midland Ave., Detroit, Mich., has developed the No. 200 Junior "De-Sta-Co" light duty toggle clamp especially for production work in the aircraft industry. This small clamp provides a clamping ratio of 33:1, for holding parts during welding, drilling, machining, assembly and other production operations. The device is made of cold drawn steel, bright cadmium plated, and weighs only 9¼ oz.

Measuring only 6x6x1$\frac{3}{16}$ in., this clamp is machined to assure free operation, yet design is such as to avoid looseness at bearing points. Special rubber bolt head helps prevent marring or denting of surfaces being clamped.

Metal-Clad Micro Switch Features Adjustable Roller Arm

A metal-clad Micro Switch with a roller arm adjustable vertically through an arc of 225 deg. around its pivot pin, and also horizontally in eight positions 45 deg. apart, has been announced by Micro Switch Corp., Freeport, Ill.

This switch is suitable for slide or cam actuation. A ¾ in. diameter roller of hardened and ground steel is carried on an oilless bronze bearing. The arm is a lightweight aluminum die-casting. Switch is rated by Underwriters' at 1200 watts up to 600 volts a.c. It is single pole only, with normally closed, normally open, or double throw contact arrangements. It has a life of more than a million operations, and operates on only 2-4 deg. movement.

1941

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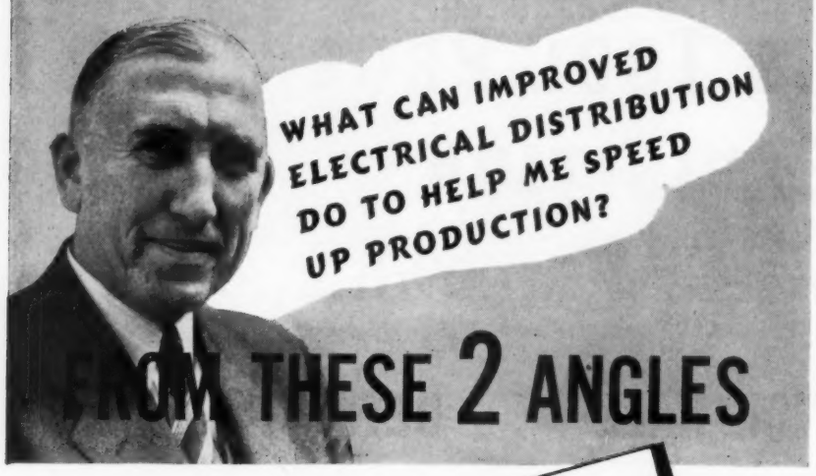

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1. Better electrical distribution IN the plant

Special *Bus-Duct** systems of plant wiring give a highly flexible power-supply service, easily installed, quickly adapted to changes in plant layout. Trol-E-Duct systems for portable tools and lighting units are ideal along production lines.

Other important advances in conduit, fittings, panelboards, wiring devices give a plant that's wired to *modern* standards a definite advantage in production efficiency as a result of fewer power interruptions, quicker change-overs, with all the "juice" you need quickly available at any point.

2. Better electrical distribution TO the plant

When you or your electrical contractor want the best in wiring supplies for industrial plants *in a hurry*, that's when you'll appreciate GRAYBAR distribution service. One call to your local GRAYBAR house will get you everything that's needed: wire, conduit, fittings, panelboards, circuit breakers, switches, etc., each the product of a leading manufacturer. What's more, every item, from tape to transformers, is backed by the satisfaction-insurance of the GRAYBAR Tag.

*Write today for Bulletin 403 describing the Modern Bulldog "BUStribution" System and showing typical installation views in metal-working plants.

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NEW MATERIALS

Synthetic Base Paint Resists Corrosive Conditions

"Koroplate" paint, to protect metal surfaces against chemical reactions and recommended for service wherever extremely corrosive conditions disqualify any other kind of paint or coating, has been developed by B. F. Goodrich Co., Akron, Ohio. Its base is "Koroseal," a synthetic material created in the Goodrich laboratories from polyvinyl chloride, which is derived by a series of chemical reactions from coke, limestone and salt.

The paint is liquid at room temperatures and requires no heating before application. At ordinary temperatures it can be either brushed or sprayed, and can be thinned with either brush or spray thinners when necessary. It must be used in conjunction with a "Koroseal" primer with similar characteristics. It is made only in semi-glossy black. The paint when thoroughly dry is extremely resistant to action of fumes and vapors from acids, alkalis and salts at room temperatures or slightly above. It resists all acids except concentrated formic and acetic, and is not affected by brass, chrome, nickel, cadmium, zinc, copper, silver or tin plating solutions. Such solutions are not contaminated or fouled by the thoroughly dried paint, although it is not recommended for constant immersion in liquids.

"Weldoloy" Brazing Alloys Melt at Low Temperatures

Brazing at exceptionally low temperatures is claimed to be made possible by the use of "Weldoloy" brazing mediums and fluxes, distributed by Weldoloy Mfg. Co., Div. of Park Sales Co., 3 Park Place, New York, N. Y. This material is available in a variety of alloys and fluxes for oxy-acetylene use, the alloys being supplied in rod form and the fluxes in powder or paste form.

"Weldoloy 690" is used for joining aluminum and its alloys, as it flows at a temperature of 930 F. This material is said to have a tensile strength of 35,000 lb. per sq.in. "Weldoloy 685," used for steel, cast iron, copper, brass, bronze, etc., flows at 750 F., and although it has a hardness of 230 Brinell, it can be easily machined. It is said to be ideal for repairing broken or worn machine parts. Other types of "Weldoloy" include the following: No. 514, for cast iron, which binds at 360 F.; No. 516, for steel, which binds at 1470 F. with a tensile strength of 115,000 lb. per sq.in., and which is particularly recommended for thin gage steel; No. 518, for copper, brass, extruded bronze, etc., which binds at 1600 F. and has a tensile strength of 65,000 lb. per sq.in.; No. 710, for cast aluminum, which binds at 950 F. with a tensile strength of 23,000 lb. per sq.in.; No. 688, for die castings, which binds at 750 F.

TRADE PUBLICATIONS

ARC WELDING Air Reduction, 60 E. 42nd St., New York, N. Y., has just issued a 16-page folder which indicates how welding decreases the weight and cost of structural steel, and eliminates cost of punching and drilling holes in construction work.

BEARINGS A 12-page booklet No. 1846, circulated by Link-Belt Co., Chicago, describes the operation and endurance features of Link-Belt bearings.

BUSHINGS Orange Roller Bearing Co., Inc., Orange, N. J., has published a 20-page bulletin which gives dimensions and describes the capacities of its line of roller bushings.

COMPRESSORS Worthington Pump & Machinery Corp., Harrison, N. J., has issued Bulletin No. L-611-B11A, which describes single horizontal two-stage compressors. The company has also published Bulletin No. L-611-B12B which describes single horizontal three-stage compressors.

DISK CLUTCH The Conway Clutch Co., 1507 Queen City Ave., Cincinnati, Ohio, has issued a bulletin, No. MGT, which describes gear tooth drive disk clutches in the 8, 10 and 12 in. sizes.

EFFECT OF PRACTICE The University of Iowa has just published a 95-page bulletin giving the results of a joint investigation conducted by the University and the Western Electric Company on "The Effect of Practice on the Elements of a Factory Operation." The bulletin sells for 75 cents per copy.

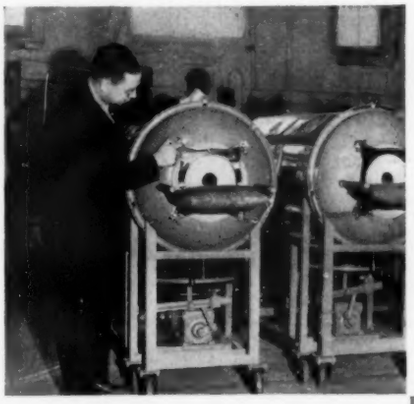
GEAR LAPPING National Broach & Machine Co., Shoemaker & St. Jean, Detroit, Mich., is circulating a four-page folder which summarizes lapping methods and indicates how distortion and other errors in gears may be corrected quickly and economically.

GEARS Michigan Tool Co., Detroit, is circulating a 44-page booklet which presents short-cuts of practical every-day assistance to those whose work involves the cutting and checking of gears.

HYDRAULIC ELEVATING TABLE Lyon Iron Works, Greene, N. Y., has published a two-page circular, No. 118, which illustrates the operation and construction of the Lyon Hydraulic Elevating Table.

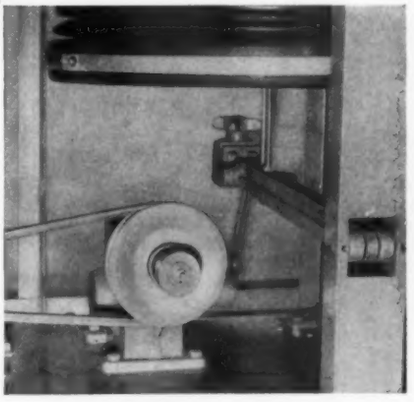
LATHES Schauer Machine Co., 2060-68 Reading Rd., Cincinnati, Ohio, has issued Circular No. 400, which describes the construction and operation of a complete line of high-production speed lathes.

"IRON LUNG" IS QUIET, NEVER-FAILING WITH TORRINGTON NEEDLE BEARINGS



1. "Torrington Needle Bearings are used at 4 vital points of the 'Iron Lung' because they can be relied on to run smoothly and silently in continuous service without wear or attention," says Mr. H. P. Roth, of Warren E. Collins, Inc., maker of the famous Drinker-Collins Respirator.

Few machines must be as absolutely dependable as the "Iron Lung." Torrington Needle Bearings are used because they are reliable, quiet and efficient.



2. "Needle Bearings perform admirably day after day, year after year," Mr. Roth adds. "They were adopted after previous bearings gave trouble due to wear, play and noise when in long use. In contrast, the Torrington Needle Bearings, lubricated at the time of installation, require little or no attention throughout the life of the product."

Can you use an anti-friction, self-contained bearing that occupies no more space than a plain bushing? Are high capacity, low initial costs and easy installation important in your product? If so, the Torrington Needle Bearing will interest you. Our Engineering Department will be glad to work with you. For detailed information, write for Catalog No. 105. For Needle Bearings to be used in heavier service, ask our associate, Bantam Bearings Corporation, South Bend, Indiana, for Catalog 103X.

THE TORRINGTON COMPANY, TORRINGTON, CONN., U. S. A. • ESTABLISHED 1866

Makers of Needle and Ball Bearings

New York Boston Philadelphia Detroit Cleveland Chicago London, England

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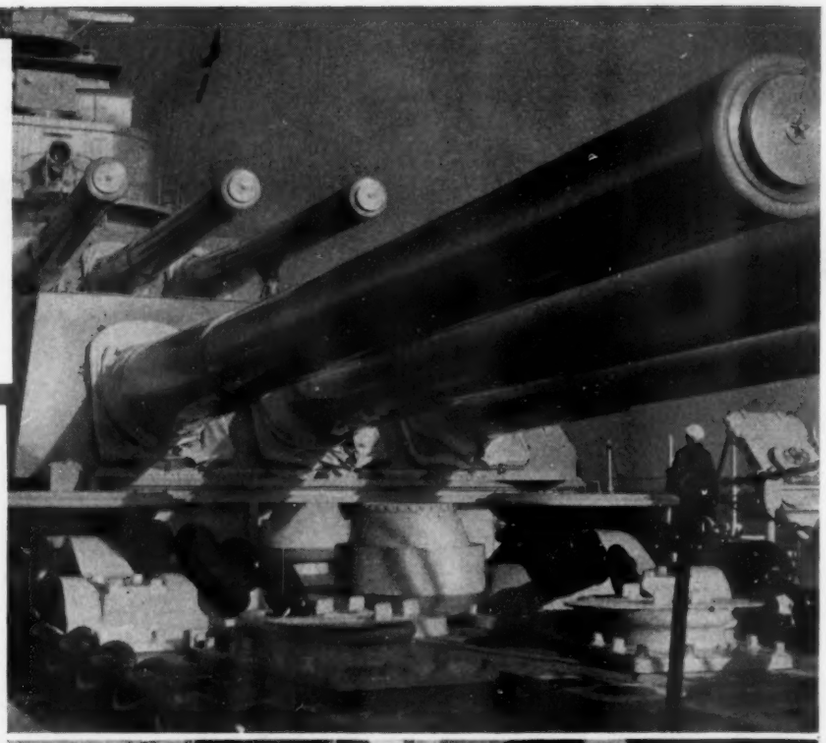
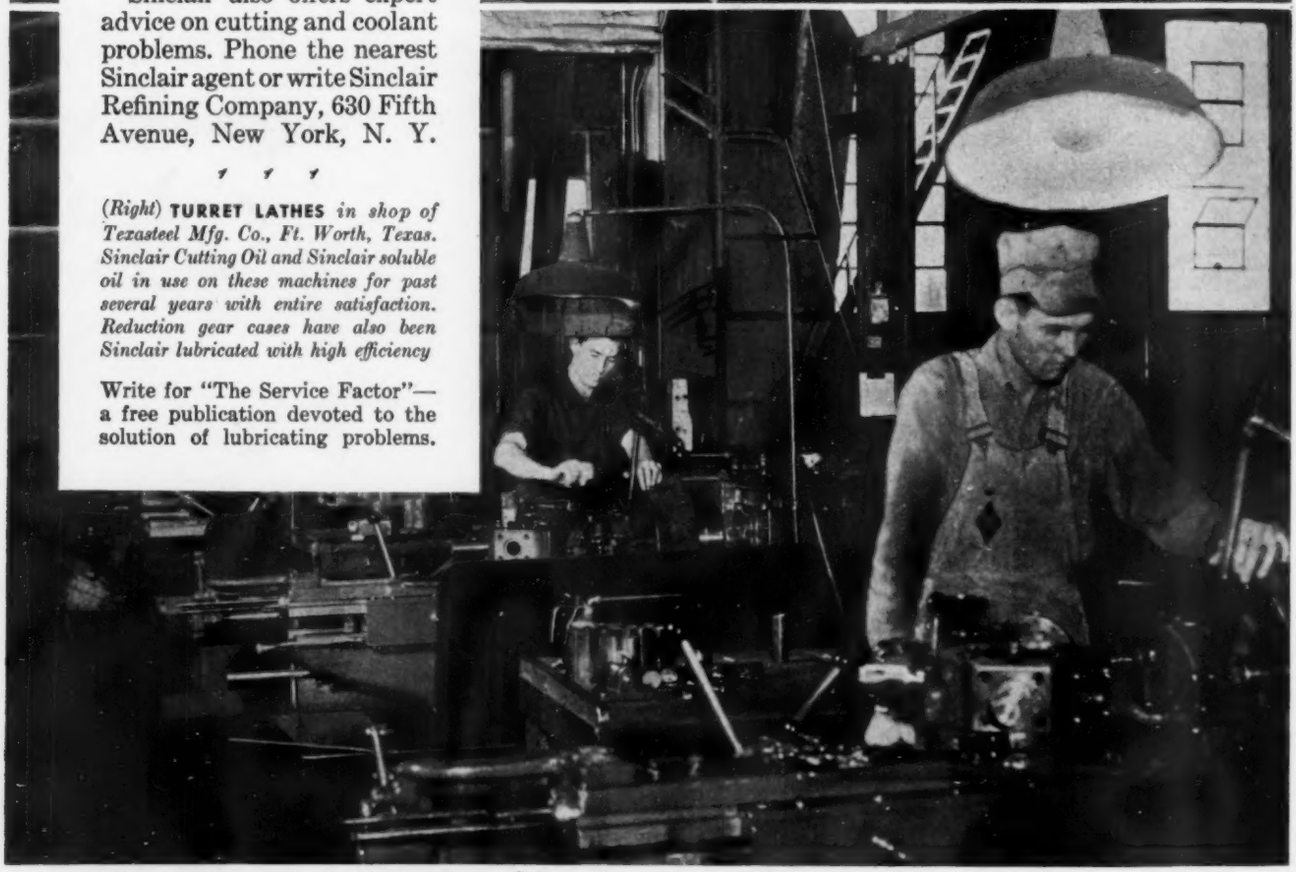
NEEDLE BEARING

NATIONAL DEFENSE speed-up is forcing heavier service loads for longer working periods on all types of industrial equipment. *Correct* lubrication is the key to sustained top performance. In all *metal cutting* operations the use of . . .

. . . SINCLAIR CUTTING OILS AND COOLANTS promotes higher cutting speeds, fewer tool grinds, lower production cost per unit. For every metal-working operation in *your* plant there's a specialized Sinclair product.

Sinclair also offers expert advice on cutting and coolant problems. Phone the nearest Sinclair agent or write Sinclair Refining Company, 630 Fifth Avenue, New York, N. Y.





(Right) **TURRET LATHES** *in shop of Texasteel Mfg. Co., Ft. Worth, Texas. Sinclair Cutting Oil and Sinclair soluble oil in use on these machines for past several years with entire satisfaction. Reduction gear cases have also been Sinclair lubricated with high efficiency*

Write for "The Service Factor"—a free publication devoted to the solution of lubricating problems.

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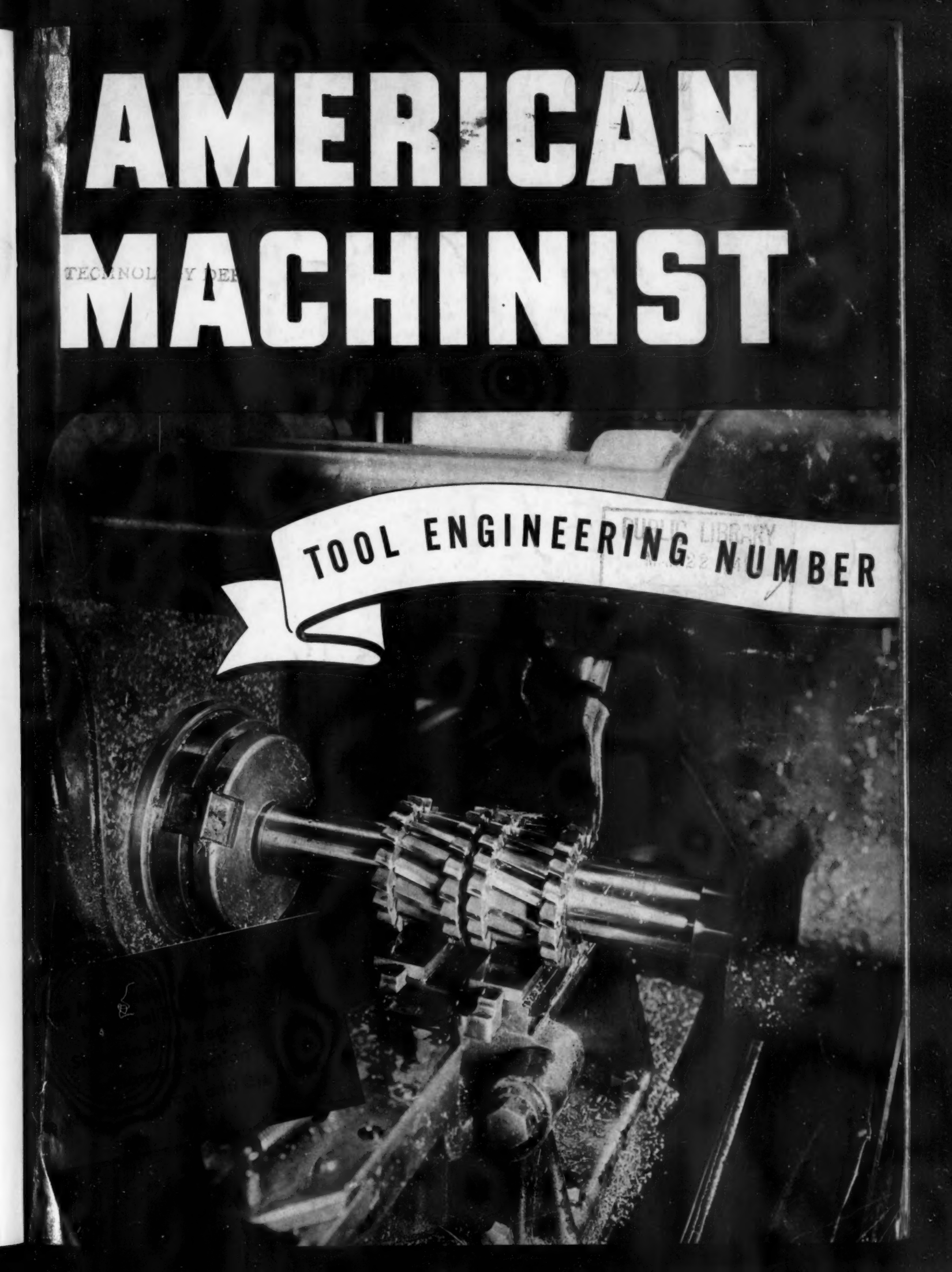
AMERICAN MACHINIST

TECHNOLOGY DEP

TOOL ENGINEERING NUMBER



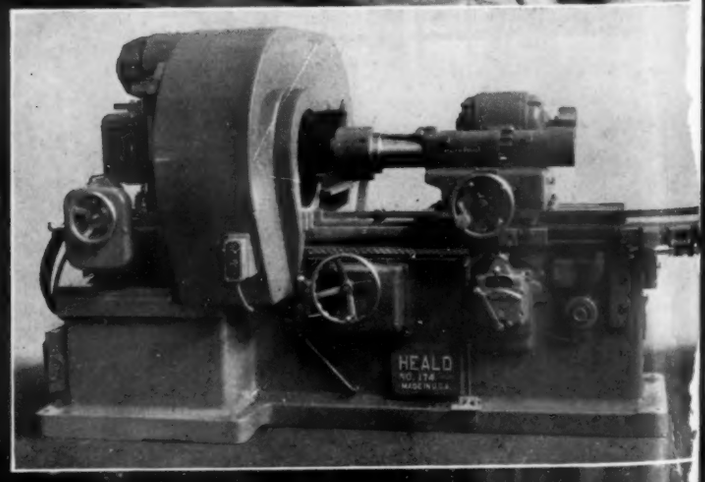
PUBLIC LIBRARY

RODS *And Other* LARGE SWING WORK

The close-up shows a No. 174 grinding large diesel rods. Swings 42" but work center only 48¼" from floor.

Large swing work of all kinds can be handled to excellent advantage on Heald Gap Type Internal Grinding Machines. Designed with gap type base which provides not only unusual swing capacity but also low work center, these machines combine ability to grind large awkward work with marked ease of operation.

Built in two sizes, the Heald No. 172 Gap Machine will swing work 36" O. D. with gap adjustment from 6" to 14"; the No. 174 Gap Machine swings work 42" O. D. and has a gap adjustment of 11½" to 20". Bulletins on either or both of these machines will be sent gladly on request.



THE HEALD MACHINE CO. WORCESTER, MASS. U. S. A.